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The Political Economy of Regulatory Risk

Roland Strausz*



* Humboldt-Universität zu Berlin, Germany

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The Political Economy of Regulatory Risk

Roland Strausz*

Humboldt-Universität zu Berlin

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Abstract

I investigate the argument that, in a two-party system with different regulatory objectives, political uncertainty generates regulatory risk. I show that this risk has a fluctuation effect that hurts both parties and an output-expansion effect that benefits one party. Consequently, at least one party dislikes regulatory risk. Moreover, both political parties gain from eliminating regulatory risk when political divergence is small or the winning probability of the regulatory-risk-averse party is not too large. Because of a commitment problem, direct political bargaining is insufficient to eliminate regulatory risk. Politically independent regulatory agencies solve this commitment problem.

Keywords: regulation, regulatory risk, political economy, independent regulatory agency

JEL Classification No.: D82

*Humboldt-Universität zu Berlin, Institute for Microeconomic Theory, Spandauer Str. 1, D-10178 Berlin (Germany), strauszr@wiwi.hu-berlin.de. I thank Helmut Bester, David Sappington, Wilfried Sand-Zantman, Yossi Spiegel, and seminar participants at the Humboldt-Universität Berlin. This work was supported by the Deutsche Forschungsgemeinschaft through the CRC 649 "Economic Risk".

1 Introduction

This paper investigates regulatory risk that is politically motivated.¹ It shows first that, in a two-party system, diverging political preferences and electoral uncertainty does indeed generate such risk. The analysis reveals, however, that in many circumstances both political parties dislike this risk and, therefore, want to prevent regulatory risk actively. In particular I show that at least one of the two parties dislikes regulatory risk, whereas the other party's preferences depends on a trade-off between a negative fluctuation and a positive output-expansion effect of regulatory risk. The negative effect dominates when differences between the parties are relatively small or when electoral uncertainty is not too much in favor of the party that has an unambiguous dislike of regulatory risk. In such political systems, both political parties prefer implementing the expected regulatory objective with certainty over waiting for the uncertain election outcome. Consequently, political parties have an interest in establishing institutions, such as political bargaining, to eliminate politically motivated regulatory risk.

Due to a time-inconsistency problem, political bargaining by itself is, however, not an effective institution for eliminating this risk. When both political parties have, from an *ex ante* point of view, an incentive to agree on a mutual beneficial deterministic regulatory policy, each party anticipates that, after the election, the winning political party will change it to its most preferred one. This *ex post* myopic behavior undermines the credibility of an *ex ante* agreement.

The paper investigates two institutions that circumvent the inherent commitment problems. First, it analyzes how cooperation based on repeated interactions can overcome the time-inconsistency problem. Second, it argues, in line with a large literature on delegation, that the problem is solved by institutionalizing a politically independent regulatory agency and endowing it with an objective function on which both parties agree *ex ante*. The paper,

¹Regulatory risk reflects the uncertainty behind new or changing regulation over time. Different surveys on business risk agree that regulatory risk is one of the greatest threat to modern businesses. For instance, the Ernst&Young 2008 survey on strategic business risk calls regulatory and compliance risk “the greatest strategic challenge facing leading global businesses in 2008”. Regulators are well aware of the problem of regulatory risk.

therefore, provides a formal rationale for the prevalence of politically independent regulatory agencies.²

I derive these results in the optimal incentive regulation framework of Baron and Myerson (1982), where a government tries to regulate a privately informed monopolist with the objective to maximize a weighted sum of consumer surplus and profits.³ I embed this framework in a political economy model, where two political parties run for election before regulating the firm. Both parties are benevolent but differ in their views about the appropriate relative weights in the social choice function between consumer and producer surplus. These different political views cause a preference for different regulatory policies. As a consequence, political uncertainty generates regulatory risk.

I show that a party's attitude towards regulatory risk is fully determined by a *fluctuation* and an *output-expansion* effect. The fluctuation effect hurts both parties unambiguously, whereas the expansion effect benefits one party, while hurting the other. As a result, at least one party unambiguously dislikes regulatory risk, whilst the other party likes regulatory risk when the expansion effect outweighs the fluctuation effect. Because the trade-off shifts in favor of the fluctuation effect when the degree of political divergence is small, both parties and, therefore, the overall political system tends to dislike regulatory risk when political differences between the two parties is small.

2 Related Literature

The theoretical literature on regulatory risk is rather small. Chang and Thompson (1989) analyze regulatory risk under rate of return regulation. Panteghini and Scarpa (2003) study the effect of regulatory risk on investment by comparing price-caps to profit-sharing rules. Both these papers compare ad-hoc regulation schemes rather than studying regulatory risk under optimal regulation. In contrast, Strausz (2009) develops, based on uncertain regulatory variables, an analytical framework to study regulatory risk in optimal monopoly regulation under asymmetric information. The current paper uses a specific version of this framework.

²OECD (2002) reports that independent regulatory agencies are currently “one of the most widespread institutions of modern regulatory governance”.

³See Armstrong and Sappington (2007) for an introduction to optimal regulation models.

Although an extensive literature investigates the multi-faceted connections between political economy and regulation, the literature has not addressed the specific relation between political economy and regulatory risk. Closest related is Laffont (2000), who analyzes the welfare trade-offs between an inflexible, constitutionally fixed regulatory schedule and a flexible schedule that reacts to changes in the marginal cost of public funds but underlies political capture by two different consumer groups. In contrast to the current paper, Laffont's framework is not cast in terms of regulatory risk.⁴ A further difference is that my paper presents a positive rather than a normative analysis.

The literature on political economy is well aware of the benefits of delegation due to commitment problems. To put my results in relation to this extensive literature, it is helpful to clarify that this literature implicitly addresses two different types of commitment problems.⁵ First, there is the time-inconsistency of Kydland and Prescott (1977), which shows that a decision maker is hurt when he cannot commit to its future, short run decisions. The problem here is a lack of *self-commitment*. Hold-up problems are examples of self-commitment problems. Without self-commitment, the decision maker benefits from delegating future decisions to a third party in order to bind itself.⁶ This motivation for delegation is however unrelated to political uncertainty; the underlying self-commitment problem is not due to a (possible) change of the decision maker. My framework, therefore, shares with this literature that the benefits of delegation are due to a self-commitment problem. A crucial difference is, however, that in my framework the self-commitment problem plays only a role when there is political uncertainty.

The strand of the literature that explicitly connects delegation with political uncertainty concentrates on a different commitment problem: The inability of current holder of public authority (e.g., current voters or elected politicians) to constrain the decisions of future holders of public authority. An extensive literature studies the implications of this commitment problem (e.g., Glazer 1989, Persson and Svensson 1989, Alesina and Tabellini 1988,

⁴Strausz (2009) shows that stochastic changes in the marginal cost of public funds also generate regulatory risk.

⁵Gilardi (2005a) examines the explanatory power of the two different types of commitment problems for the political independence of regulatory agencies.

⁶A prominent example in the context of monetary policy is the argument in favor of central bank independence (Rogoff 1985).

1990; Tabellini and Alesina 1990). For this literature, the underlying problem is not one of self-commitment but rather one of committing others. Moe (1990, p.229), for example, argues that it induces current public authority holders to use delegation as “protective devices for insulating agencies from political enemies”. Vogel (1996, p.131) applies this view directly to regulation when he observes that “Thatcher administration officials favored independent regulators because of the dynamics of alternance in British politics. The party in power wants to be able to infiltrate the bureaucracy, but by the same token wants to guard it from future infiltration by the other party.” Although my paper shares with this literature the importance of political uncertainty, it differs in that the underlying commitment problem which delegation helps to solve is actually a self-commitment problem rather than committing future public authority holders.

3 The Setup

Consider a monopolistic firm that produces a publicly provided good x at a constant marginal cost. There are no fixed costs. Given marginal costs c , the firm’s profit from producing a quantity x for a lump-sum transfer t is

$$\Pi(t, x|c) \equiv t - cx.$$

Marginal costs are c_l with probability ν and c_h with probability $1-\nu$, where $\Delta c \equiv c_h - c_l > 0$. The firm, however, is perfectly informed about its marginal costs c .

When consumers pay a lump-sum transfer t in exchange for the consumption of a quantity x , they obtain the consumer surplus

$$\Psi(t, x) \equiv v(x) - t.$$

The term $v(x)$ expresses the consumers’ overall utility from the consumption of a quantity x of the good. I follow the standard assumption that consumer’s marginal utility of the good x is positive but decreasing, i.e., $v' > 0$ and $v'' < 0$. Moreover, I assume that v''' exists, but make no assumptions about its sign. Because v' represents the consumers’ (inverse) aggregate demand function, the third derivative v''' determines the curvature of the consumers’

aggregate demand function.⁷ As a consequence, the demand function is convex exactly when v''' is non-negative. The regulatory framework is similar to Strausz (2009), which provides the insight that the curvature of the demand function plays a crucial role in how regulatory risk affects regulatory outcomes.

Before regulation takes place, there is a general election between a party l and a party r . The election determines the ruling party that runs the government and, ultimately, decides about the regulation. I assume that the election exhibits some randomness which, for simplicity, I take as exogenous: Party r wins the election with probability $\alpha \in (0, 1)$ and party l wins it with probability $1 - \alpha$.⁸ After the election, the winning party's task is to regulate the monopolistic firm.

I assume that both parties are benevolent in that they maximize a social choice function W that is a weighted sum of the consumer surplus and the firm's profits:

$$W = \Psi + \lambda\Pi, \tag{1}$$

where the parameter $\lambda \in [0, 1)$ represents the weight attached to profits. One interpretation is that the two parties differ in their perception of the appropriate weight λ in society's social choice function. Without loss of generality, I assume that the party r has a more business friendly orientation so that $\Delta\lambda \equiv \lambda_r - \lambda_l > 0$. In particular, a firm that receives a transfer t and produces a quantity x at marginal costs c_i yields party $p \in \{l, r\}$ a payoff of

$$W_p(x, t, c_i) \equiv \Psi(x, t) + \lambda_p\Pi(x, t) = v(x) - \lambda_p c_i x + (1 - \lambda_p)t.$$

To summarize, the triple $(\alpha, \lambda_l, \lambda_r)$ describes the *political system*. For a given political system, I define $\Delta\lambda \equiv \lambda_r - \lambda_l$ as the measure of *political divergence* of the system.

⁷The consumer's demand $x(p)$ solves $\max_x v(x) - px$ and satisfies the first order condition $v'(x(p)) = p$. By the implicit function theorem, differentiating twice and rearranging terms yields $x''(p) = -v'''(x(p))x'(p)^2/v''(x(p))$.

⁸In principle, α could be determined by a more elaborate political economy model. The crucial assumption is that there is at least some uncertainty about the election outcome so that $\alpha \in (0, 1)$. This obtains, for instance, when the preferences of the electorate exhibit some randomness or when the outcome of the elections depend on other uncertain political issues than the regulatory problem alone. Essentially, the model takes seriously that elections in real life always have at least some degree of uncertainty.

4 Optimal Regulation

In this section, I calculate the optimal regulatory schedule for a given social choice function W . From the revelation principle, it follows that the optimal regulation contract is a direct mechanism (t_l, x_l, t_h, x_h) that gives the firm an incentive to report its true cost type c_i . Consequently, the optimal regulatory contract is a solution to the following maximization problem:

$$P : \max_{x(\cdot), t(\cdot)} \quad \nu W_p(x_l, t_l, c_l) + (1 - \nu) W_p(x_h, t_h, c_h) \quad (2)$$

$$\text{s.t.} \quad t_h - c_h x_h \geq t_l - c_h x_l \text{ and } t_l - c_l x_l \geq t_h - c_l x_h \quad (3)$$

$$t_l \geq c_l x_l \text{ and } t_h \geq c_h x_h, \quad (4)$$

where (3) represents the incentive compatibility conditions that ensure truth-telling and (4) represents the firm's participation constraints and reflect the implicit assumption that both types of firm are required to operate.

As is well known, only the incentive compatibility of the efficient firm c_l and the individual rationality constraint of the inefficient firm c_h are binding. Solving for these two constraints yields the transfers $t_h = c_h x_h$ and $t_l = c_l x_l + \Delta c x_h$. Substituting out the transfers, problem P simplifies to maximizing the expression

$$\tilde{W}_p(x_l, x_h) \equiv \nu[v(x_l) - c_l x_l - (1 - \lambda_p)\Delta c x_h] + (1 - \nu)[v(x_h) - c_h x_h]$$

with respect to the quantities x_l and x_h .

The first order conditions that characterize the optimal quantity schedules (\hat{x}_l, \hat{x}_h) are

$$v'(\hat{x}_l) = c_l \text{ and } v'(\hat{x}_h) = c_h + (1 - \lambda)\psi\Delta c, \quad (5)$$

where $\psi \equiv \nu/(1 - \nu)$. Hence, we obtain the standard result that the allocation of the efficient type coincides with the first best and the allocation of the inefficient type is distorted downwards. Consequently, only the output \hat{x}_h depends on the parameter λ .

The optimal regulatory schedule for a given profit-weight λ yields party p the payoff

$$\hat{W}_p(\lambda) \equiv \tilde{W}_p(\hat{x}_l, \hat{x}_h(\lambda)).$$

The following lemma confirms the intuitive but helpful property that \hat{W}_p attains a maximum at λ_p .

Lemma 1 *The function \hat{W}_p is increasing for $\lambda < \lambda_p$ and decreasing for $\lambda > \lambda_p$. It attains a unique maximum at λ_p so that $\hat{W}'_p(\lambda_p) = 0$ and $\hat{W}''_p(\lambda_p) < 0$.*

Using the implicit function theorem and differentiating expression (5) with respect to λ yields

$$\hat{x}'_h(\lambda) = -\frac{\psi \Delta c}{v''(\hat{x}_h)}. \quad (6)$$

Due to $v'' < 0$, the derivative $\hat{x}'_h(\lambda)$ is positive and, therefore, $\hat{x}_h(\lambda_l) \leq \hat{x}_h(\lambda_r) \leq x_h^{fb}$. This illustrates the intuitive result that the more business friendly party r asks the firm to produce more. The explanation is that more production leads, due to higher information rent, to higher profits, which party r discounts less than party l .

Further differentiation with respect to λ and a rearrangement of terms yields

$$\hat{x}''_h(\lambda) = -\frac{v'''(\hat{x}_h(\lambda))}{v''(\hat{x}_h(\lambda))} [\hat{x}'_h(\lambda)]^2. \quad (7)$$

The expression shows that the sign of $\hat{x}''_h(\lambda)$ coincides with the sign of v''' . Because v''' represents the curvature of the consumer's demand function, the schedule $\hat{x}_h(\lambda)$ is convex when the consumer's demand is convex. If the demand function is concave, then the schedule $\hat{x}(\lambda)$ is concave. Strausz (2009) shows that this one-to-one relationship between the curvature of the demand function and the regulatory schedule holds more generally and is not particular to the binary character of asymmetric information.

5 Regulatory Risk

Electoral uncertainty implies that the high cost firm will produce output $\hat{x}_h(\lambda_r)$ with probability α and the output $\hat{x}_h(\lambda_l)$ with probability $1 - \alpha$. Hence, uncertain elections generate uncertain regulation outcomes and, therefore, regulatory risk. Due to this risk, the *ex ante* expected payoff of party p is

$$W_p^e(\alpha) \equiv \alpha \hat{W}_p(\lambda_r) + (1 - \alpha) \hat{W}_p(\lambda_l). \quad (8)$$

In this section, I ask the question how political parties evaluate the regulatory risk and whether they have incentives to reduce or even eliminate it. Following the standard approach

towards risk attitudes, I say that *a political party dislikes regulatory risk* when its expected payoff with the risk is smaller than its payoff under its expected policy preference⁹

$$\lambda_e(\alpha) \equiv \alpha\lambda_r + (1 - \alpha)\lambda_l.$$

According to this definition, a political party p dislikes regulatory risk in a political system $(\alpha, \lambda_l, \lambda_r)$ exactly when

$$\hat{W}_p(\lambda_e(\alpha)) \geq W_p^e(\alpha). \quad (9)$$

In contrast, a party likes regulatory risk when the inequality is reversed. Consequently, the curvature of \hat{W}_p determines party p 's attitude towards risk. In particular, party p dislikes regulatory risk, when its payoff \hat{W}_p is concave in λ . In contrast, the political party likes the risk, when its payoff function \hat{W}_p is convex. The following lemma establishes a sufficient condition under which a party's payoff \hat{W}_p is concave around λ .

Lemma 2 *The function $\hat{W}_p(\lambda)$ is concave around λ when*

$$(\lambda_p - \lambda)\psi\Delta cv'''(\hat{x}_h(\lambda)) < [v''(\hat{x}_h(\lambda))]^2. \quad (10)$$

When the local condition (10) holds globally, the function $\hat{W}_p(\lambda)$ is concave globally, which implies that party p dislikes regulatory risk in general. Because the expected policy preference λ_e lies in between λ_l and λ_r , the relevant interval for considering the curvature of $\hat{W}_p(\lambda)$ is $[\lambda_l, \lambda_r]$ rather than the overall domain $[0, 1]$. For $\lambda \in [\lambda_l, \lambda_r]$, all the signs of the different terms in (10) are unambiguously determined except for v''' . We, therefore, obtain the following insights about the parties' risk preferences.

Proposition 1 *When demand is globally concave ($v''' < 0$), party r dislikes regulatory risk. When demand is globally convex ($v''' > 0$), party l dislikes regulatory risk. For linear demand ($v''' = 0$), both parties dislike regulatory risk.*

Proposition 1 follows directly from Lemma 2, because inequality (10) is closely related to the curvature of the demand function. Hence, if the sign of the curvature does not

⁹Hence, the uncertain distribution α is a mean preserving spread of the degenerated distribution $\lambda_e(\alpha)$ in the sense of Rothschild and Stiglitz (1970).

change then, for a specific party, inequality (10) holds globally. Proposition 1 is, however, uninformative about risk preferences for demand curves with a changing sign of curvature. For such demand functions, the local effect of regulatory risk can change over the relevant domain $[\lambda_l, \lambda_r]$ and we have to consider the overall global effect of regulatory risk directly. In order to show that the effect of regulatory risk depends on the expected value of the output x_h , define \hat{x}_h^e as the expected output under regulatory risk:

$$\hat{x}_h^e(\alpha) \equiv \alpha \hat{x}_h(\lambda_r) + (1 - \alpha) \hat{x}_h(\lambda_l).$$

The next lemma shows that if the expected output under regulatory risk is smaller than the output under the expected policy weight λ_e , party r dislikes regulatory risk. Contrary, party l dislikes regulatory risk, when the expected output under regulatory risk is larger than the output under the expected policy weight λ_e .

Lemma 3 *If $\hat{x}_h^e(\alpha) \leq \hat{x}_h(\lambda_e(\alpha))$, then party r dislikes regulatory risk. If $\hat{x}_h^e(\alpha) \geq \hat{x}_h(\lambda_e(\alpha))$, then party l dislikes regulatory risk.*

From the previous lemma it follows that, independent of the demand curve, at least one political party dislikes regulatory risk.

Proposition 2 *In any political system $(\alpha, \lambda_l, \lambda_r)$ there exists at least one political party that dislikes regulatory risk.*

Although Proposition 2 tells us that at least one party dislikes regulatory risk, it does not tell us which of the two parties this actually is. To address this question, observe that Proposition 1 suggests that the curvature of the demand function, v''' , plays a crucial role. The intuition is that regulatory risk has two distinct effects: a *fluctuation effect* and an *output expansion-contraction effect*. I now argue that the sign of the fluctuation effect is unambiguously negative, whereas the sign of the second effect depends exactly on the curvature of the demand function.

First, with regulatory risk output fluctuates between $\hat{x}_h(\lambda_l)$ and $\hat{x}_h(\lambda_r)$. Because of the consumers' decreasing marginal utility, benevolent parties dislike such fluctuations. Hence, this first effect leads to an unambiguous dislike of regulatory risk. Indeed, for linear demand, regulatory risk has no additional effect and the fluctuation effect of regulatory risk fully

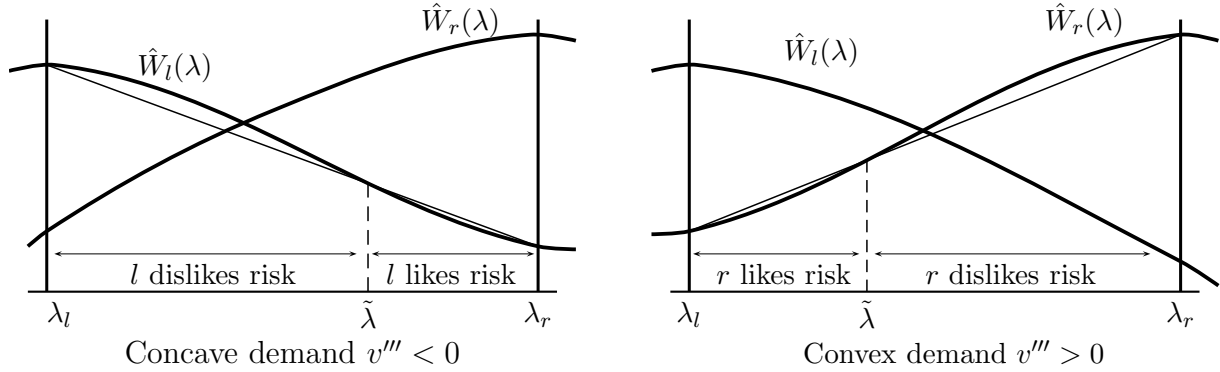


Figure 1: Non-concave payoff functions

explains the result of Proposition 1 that, with linear demand, both parties dislike regulatory risk.

When demand is not linear, regulatory risk has a second effect in that it also affects the expected value of the output itself. With convex demand, $v''' > 0$, the output $\hat{x}_h(\lambda)$ is convex so that regulatory risk leads to an expansion in output ($\hat{x}_h^e > \hat{x}_h(\lambda_e)$). Because party l considers the output $\hat{x}_h(\lambda_e)$ already as too high ($\hat{x}_h(\lambda_l) < \hat{x}_h(\lambda_e)$), this output expansion effect of regulatory risk hurts party l . Hence, both effects reinforce each other and cause party l to dislike regulatory risk. In contrast, the output expanding effect benefits party r , because $\hat{x}_h(\lambda_e)$ lies below its ideal value $\hat{x}_h(\lambda_r)$. Hence, the second effect contradicts the first effect and when demand is convex enough, the positive output expansion effect outweighs the negative fluctuation effect of regulatory risk.

The opposite logic holds when demand is concave ($v''' < 0$). In this case, the output $\hat{x}_h(\lambda)$ is concave so that regulatory risk leads to a contraction of output in expected terms. For party r , the contraction reinforces the negative fluctuation effect. For party l , however, the contraction is beneficial and, therefore, contradicts the fluctuation effect.

Figure 1 illustrates the role of curvature further. When demand is concave ($v''' < 0$), condition (10) is, due to the output contraction effect, satisfied for any $\lambda < \lambda_p$. This implies that the curve \hat{W}_p is concave for all weights λ that are smaller than the party's ideal weight

λ_p . As illustrated in the first graph of Figure 1, this implies for party r that its payoff function \hat{W}_r is concave for the entire range $[\lambda_l, \lambda_r]$. For $\lambda > \lambda_p$, a party p benefits from the output contraction effect and, for λ large enough, condition (10) is, therefore, violated. As illustrated in the first graph of Figure 1, this implies that there exist a range of $[\tilde{\lambda}, \lambda_r]$ such that party l actually likes regulatory risk. The graph indicates that this happens in political systems $(\alpha, \lambda_l, \lambda_r)$, where political divergence, $\Delta\lambda$, is large and political uncertainty is small in that α is close to 1.

The reverse logic holds when demand is convex. In this case, regulatory risk has an output expansion effect, which hurts a party p for $\lambda > \lambda_p$ and benefits it for $\lambda < \lambda_p$. As a result, the curve \hat{W}_p is concave for any $\lambda > \lambda_p$ but not necessarily for $\lambda < \lambda_p$. Consequently, party l dislikes regulatory risk for any expected weight λ_e , whereas party r likes regulatory risk when the political divergence, $\Delta\lambda$, is large enough and α is close to zero so that λ_e lies close to λ_l . In the second graph of Figure 1, this is exactly the case for the range $[\lambda_l, \tilde{\lambda}]$.

Proposition 2 reveals that at least one political party dislikes regulatory risk, but Figure 1 illustrates that the other party may or may not like it. I next characterize political systems in which both parties dislike regulatory risk. I define such systems as *political systems that are averse to regulatory risk*.

Because the curve $\hat{W}_p(\lambda)$ reaches, by definition, its maximum at λ_p , it is necessarily concave at λ_p . Hence, a party's social choice function $\hat{W}_p(\lambda)$ is concave for weights λ close to the party's ideal weight λ_p . This reasoning suggests that a party's payoff tends to be concave over the whole range $[\lambda_l, \lambda_r]$ when this range is small. Hence, the degree of political divergence, $\Delta\lambda$, seems to play an important role in determining the risk attitude of political systems. To make the connection between risk attitudes and the political divergence more precise, define¹⁰

$$\bar{\lambda} \equiv \min_{x \in [0, \hat{x}_h(1)]} \frac{(v''(x))^2}{|v'''(x)|\psi\Delta c}. \quad (11)$$

This definition leads to the following result.

¹⁰If $v'''(x) = 0$ for all $x \in [0, \hat{x}_h(1)]$, then $\bar{\lambda} = \infty$.

Proposition 3 *A political system $(\alpha, \lambda_l, \lambda_r)$ is averse to regulatory risk whenever political divergence $\Delta\lambda$ is small and, in particular, smaller than $\bar{\lambda}$.*

According to Lemma 3 at least one party dislikes the regulatory risk. When we denote this party as the *regulatory risk averse party*, it follows that the other party dislikes regulatory risk when the winning probability of this party is not too large. This leads to the following result.

Proposition 4 *A political system $(\alpha, \lambda_l, \lambda_r)$ is averse to regulatory risk whenever the winning probability of the regulatory risk averse party is small enough.*

The proposition shows that a sufficient condition for a political system to be regulatory risk averse is that the party that is not regulatory risk averse is likely enough to win. This implies that a necessary condition for this party to like regulatory risk is that it is relatively unlikely to win the election. At first sight this may seem surprising, but Figure 1 illustrates the intuition behind the result. When the party that may potentially prefer regulatory risk is likely to win, its payoff function is necessarily concave around the expected value λ_e . Therefore, also this party has a tendency to dislike regulatory risk.

6 Pre-electoral Bargaining

When the political system is averse to regulatory risk, it has an interest in eliminating it. One way of doing so is to institutionalize a procedure of *pre-electoral bargaining* which allows political parties to write binding agreements about future regulation before the election takes place. In political systems that are averse to regulatory risk, efficient pre-electoral bargaining leads to an elimination of regulatory risk, because the political parties themselves strictly benefit from regulating the firm on the basis of the expected regulatory variable λ^e rather than waiting for the uncertain election outcome. General pre-electoral bargaining procedures may, however, also allow and lead to agreements on other regulatory variables than the expectation λ^e . It raises the question from which regulatory variables λ both parties potentially benefit. This section concentrates on this more general question. For a given political system, it fully characterizes the set of deterministic regulatory variables λ from which both parties benefit.

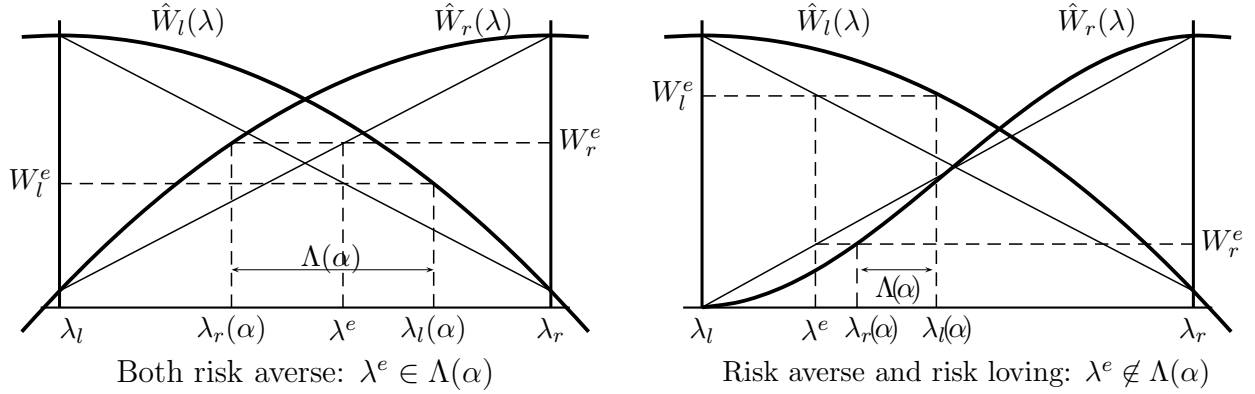


Figure 2: Mutual beneficial pre-electoral agreements $\Lambda(\alpha)$

In order to characterize the set of beneficial regulatory variables, it is helpful to consider the regulatory variable $\lambda_p(\alpha)$ for which a party p is indifferent between the stochastic outcome under regulatory risk and regulating the firm on the basis of the deterministic regulatory variable $\lambda_p(\alpha)$. Hence, let $\lambda_p(\alpha) \in [\lambda_l, \lambda_r]$ satisfy the relation

$$\hat{W}_p(\lambda_p(\alpha)) = W_p^e.$$

Because \hat{W}_p is monotone on the interval $[\lambda_l, \lambda_r]$ and W_p^e lies in between $\hat{W}_p(\lambda_l)$ and $\hat{W}_p(\lambda_r)$, the value $\lambda_p(\alpha)$ exists and is unique.

Because \hat{W}_l is decreasing on $[\lambda_l, \lambda_r]$, it follows that party l strictly prefers regulation on the basis of any $\lambda < \lambda_l(\alpha)$ to the regulatory risk outcome. Similarly, party r strictly prefers regulation on the basis of any $\lambda > \lambda_r(\alpha)$ to the regulatory risk outcome. Hence, if $\lambda_r(\alpha) < \lambda_l(\alpha)$ then for any $\lambda \in (\lambda_r(\alpha), \lambda_l(\alpha))$ both parties prefer it to the regulatory risk outcome. The first graph in Figure 2 illustrates the construction of $\Lambda(\alpha)$ in the case where both parties dislike regulatory risk. The second graph illustrates the case where one party actually likes regulatory risk. In both cases, $\lambda_r(\alpha) > \lambda_l(\alpha)$ so that a non-empty set of beneficial regulatory variables exists. Yet, if $\lambda_r(\alpha) > \lambda_l(\alpha)$ then there does not exist a mutual beneficial λ . We, therefore, obtain the following results.

Proposition 5 *In a political system $(\alpha, \lambda_l, \lambda_r)$ pre-electoral agreement is potentially bene-*

ficial if and only if $\lambda_r(\alpha) < \lambda_l(\alpha)$. In this case, it is beneficial for any $\lambda \in \Lambda(\alpha)$ with

$$\Lambda(\alpha) \equiv (\lambda_r(\alpha), \lambda_l(\alpha)).$$

For a political system that is averse to regulatory risk, we have, as illustrated in the first graph of Figure 2, $\lambda^e \in \Lambda(\alpha)$. Hence, in such political systems the set $\Lambda(\alpha)$ is non-empty and, in general, not a singleton. Proposition 5 shows moreover that the parties also benefit from regulating on the basis from other regulatory variables than the expected value λ^e . A common dislike of regulatory risk is, therefore, a sufficient condition for the existence of beneficial pre-electoral agreements but, as illustrated in the second graph of Figure 2, not a necessary one. In this case, beneficial pre-electoral agreements may exist even if regulating on the basis of the expected value λ^e is not mutually beneficial.

Clearly, within the set $\Lambda(\alpha)$, the two parties have diverging preferences. In particular, party l prefers $\lambda_r(\alpha)$ whereas party r prefers $\lambda_l(\alpha)$. It then depends on the relative bargaining strengths and the specific bargaining procedure which $\lambda \in \Lambda(\alpha)$ the parties will agree on.

7 Commitment Problems

If pre-electoral agreements are potentially beneficial, then both political parties prefer regulating the firm on the basis of some deterministic policy variable $\lambda \in \Lambda(\alpha)$ to waiting for the uncertain election outcome. Under efficient bargaining, one may, therefore, expect the political parties to eliminate the regulatory risk problem by agreeing on a deterministic policy variable $\lambda^a \in \Lambda(\alpha)$ before the election.

A problem is, however, that, after the election, the winning party p has an incentive to implement a regulatory schedule that is based on its preferred policy variable λ_p . Hence, even though parties have an incentive to agree to some deterministic policy variable λ *before* the election, the winning party wants to change it *after* the election. Such *ex post* changes undermine the pre-electoral agreement and make them non-credible. The political system, therefore, faces a commitment problem that undermines the implementation of mutual beneficial agreements.

In this section, I study and compare two institutions by which political parties can overcome the commitment problem. The first institution is *cooperation by repeated interaction*. I thereby follow the approach of De Figueiredo (2002). The second institution is *delegation*. The section identifies and compares the circumstances under which these two institutions sustain pre-electoral agreements despite the commitment problem.

To study the viability of the first institution, I consider an infinite super game with stage games that coincide with the static regulation game of the previous section. Hence, each period starts with an election that determines the winning party, which then chooses the regulatory variable λ by which to regulate the firm. The period ends with each party receiving its payoff based on the chosen regulatory variable λ . Between periods, these period payoffs are discounted with a discount factor $\delta \in (0, 1)$.

Following De Figueiredo (2002), I study the power of grim trigger strategies to sustain cooperation at a policy variable λ^a in the repeated game. These strategies describe the following behavior of a political party p . If a political party p wins the election, it regulates on the basis of the pre-electoral agreement λ^a if the firm has been regulated on the basis of λ^a in all previous periods. As soon as, some party choose some other policy parameter $\lambda' \neq \lambda^a$, the political party p will regulate on the basis of its myopically preferred regulatory variable λ_p . When these strategies are mutually best responses, they form an equilibrium and, despite the commitment problem, establish the cooperative outcome λ^a .

When parties regulate the firm on the basis of λ^a in each period, then party p expects the discounted payoff

$$W_p^c(\lambda^a) \equiv \sum_{t=0}^{\infty} \delta^t \hat{W}_p(\lambda^a) = \frac{\hat{W}_p(\lambda^a)}{1 - \delta}.$$

Instead of cooperating and choose λ^a , a political party can, after winning the election, implement its most preferred policy λ_p . This yields a period-payoff $\hat{W}_p(\lambda_p)$. After this defecting behavior, the grim trigger strategy leads also the other party to pick its most preferred policy so that period-payoffs are from then on W_p^e . Hence, the payoff from defecting and choosing λ_p instead of λ^a yields party p

$$W_p^d \equiv \hat{W}_p(\lambda_p) + \sum_{t=1}^{\infty} \delta^t W_p^e = \hat{W}_p(\lambda_p) + \delta \frac{W_p^e}{1 - \delta}.$$

By the single deviation principle, it then follows that the grim trigger strategies form an equilibrium exactly when

$$W_l^c(\lambda^a) \geq W_l^d \text{ and } W_r^c(\lambda^a) \geq W_r^d.$$

Let $\bar{\lambda}_p(\delta) \in [\lambda_l, \lambda_r]$ satisfy the relation¹¹

$$\hat{W}_p(\bar{\lambda}_p(\delta)) = (1 - \delta)\hat{W}_p(\lambda_p) + \delta W_p^e.$$

In particular, we have $\bar{\lambda}_p(1) = \lambda_p(\alpha)$.

Proposition 6 *In a political system $(\alpha, \lambda_l, \lambda_r)$, pre-electoral agreement on the policy variable λ^a is sustainable with repeated cooperation if and only if $\bar{\lambda}_r(\delta) \leq \bar{\lambda}_l(\delta)$ and*

$$\lambda^a \in \bar{\Lambda}(\delta) \equiv [\bar{\lambda}_r(\delta), \bar{\lambda}_l(\delta)].$$

The proposition shows that the set of sustainable pre-electoral agreements is $\bar{\Lambda}(\delta)$. Consistent with the theory of repeated games, the size and non-emptiness of this set depends on the discount factor δ . In particular, the set is monotone decreasing in δ in the sense that if $0 < \delta_1 < \delta_2 \leq 1$ then $\bar{\Lambda}(\delta_1) \subset \bar{\Lambda}(\delta_2)$. Moreover, $\bar{\Lambda}(1) = \Lambda(\alpha)$, which implies that any λ^a in the interior of $\Lambda(\alpha)$ is sustainable with repeated actions when the discount factor is close enough to one.

Figure 3 illustrates the construction of $\bar{\Lambda}(\delta)$. It illustrates that, for $\delta = 1$, the set coincides with $\Lambda(\alpha)$ and illustrates how it shrinks when δ becomes smaller and vanishes for some critical $\bar{\delta} > 0$. We can regard the associated policy variable $\bar{\lambda}$ as *the most stable pre-electoral agreement* of the political system.

Proposition 7 *In a political system $(\alpha, \lambda_l, \lambda_r)$, the minimum discount factor that is required for sustainable pre-electoral agreements $\bar{\delta}$ satisfies $\bar{\lambda}_l(\bar{\delta}) = \bar{\lambda}_r(\bar{\delta})$. The most stable pre-electoral agreement $\bar{\lambda}$ equals $\bar{\lambda}_l(\bar{\delta})$.*

¹¹Existence and uniqueness of $\bar{\lambda}_l(\delta)$ is guaranteed, because \hat{W}_p is monotone and $\max\{\hat{W}_p(\lambda_l), \hat{W}_p(\lambda_r)\} \geq \bar{W}_p(\delta) \geq \min\{\hat{W}_p(\lambda_l), \hat{W}_p(\lambda_r)\}$.

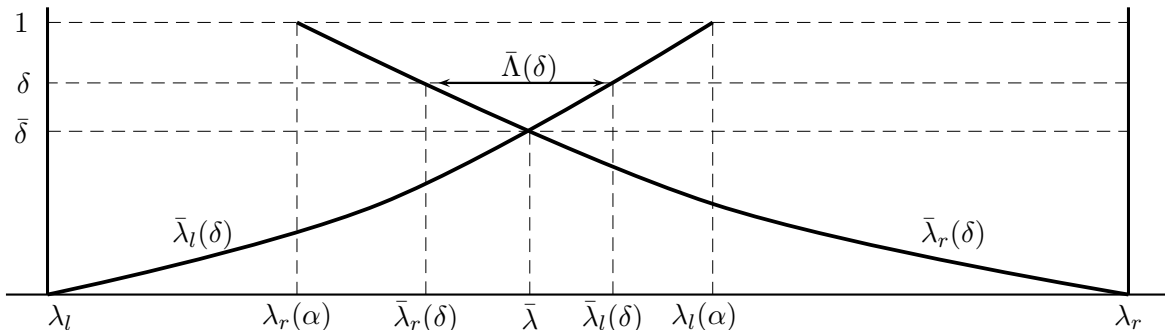


Figure 3: Sustainable pre-electoral agreements $\bar{\Lambda}(\delta)$

The most stable pre-electoral agreement, $\bar{\lambda}$ depends on the political system and, in particular, on the electoral probability α . A question that naturally arises is which electoral probability α yields the lowest critical discount factor $\bar{\delta}$. In contrary to the framework of De Figueiredo (2002), this lowest critical discount factor does generally not obtain for $\alpha = 1/2$ where electoral uncertainty is maximal.¹²

When the discount factor is too low and, in particular, lower than $\bar{\delta}(\alpha)$ then repeated interactions are not strong enough to circumvent the commitment problem. This leads us to consider a second institutional arrangement, which the literature commonly views as an attempt to circumvent time-inconsistency problems: *delegation*. Indeed, the political parties could create a politically independent institution and give it the responsibility to regulate the firm on the basis of some policy variable λ^a . Indeed, in practise regulation is often institutionalized and delegated to independent regulatory agencies that have a mandate which extends beyond the electoral cycle. The commitment problem and a dislike of political parties for regulatory risk offer an explanation of this practise.

Corollary 1 *For $\delta < \bar{\delta}(\alpha)$, the political system has an interest in institutionalizing a politically independent regulatory agency in order to circumvent a commitment problem and reduce regulatory risk in a credible way.*

¹²A special case, where this does obtain is $v(x) = a\sqrt{x} + b$.

The corollary provides a formal explanation for the observation that independent regulatory agencies are currently “one of the most widespread institutions of modern regulatory governance” (OECD 2002). The result is also consistent with the empirical observation that regulatory agencies tend to be more independent in countries where there is frequent turnover between governments with different preferences (Gilardi 2005a, p.141 and Gilardi 2005b).

The literature that explains delegation on the basis of commitment problems exhibits a logical tension, because it effectively assumes that commitment by delegation is easier to achieve than direct commitment. In my context, for instance, Corollary 1 presumes that it is possible for political parties to commit not to interfere with the regulatory agency but they can, due to the small discount rate, not commit to direct agreements between them. The literature on delegation provides no rigorous arguments why this should be the case. Nevertheless, empirical observations strongly suggest that commitment by delegation is easier to sustain than direct agreements. Corollary 1 follows from these observations. Moreover, the literature is also aware that there is a difference between formal and actual independence of regulatory agencies. Gilardi (2004) measures the degree of independence for different regulatory agencies in different countries.

8 Conclusion and Discussion

Regulatory risk affects political parties through a fluctuation and an output–expansion effect. The fluctuation effect hurts both parties, whereas exactly one party benefits from the output–expansion effect. When the negative fluctuation effect dominates, regulatory risk hurt both parties. This is the case when the political divergence between the two parties is not too large or when the probability of the party who benefits from the output–expansion effect is small enough. In this case, political parties have an incentive to reduce regulatory risk. Due to self–commitment problems, the parties may have a further incentive to delegate regulation to an independent regulatory agency.

The insights of this paper are general, because the analysis identifies the two driving effects of regulatory risk. This suggests, in particular, that similar results also hold when regulatory risk is generated by something else than political uncertainty. Moreover, also when

regulatory risk is, as suggested in Strausz (2009), due to uncertainty about the marginal costs of public funds, the two identified effects determine the parties' preferences with respect to regulatory risk. The analysis, therefore, yields the general insight that political parties have no unambiguous interest in generating regulatory risk artificially. Hence, even if independent regulatory agencies are created for different reasons than for a lack of commitment, political parties still have an incentive to endow the agency with a robust, stable objective function that minimizes regulatory risk.

I considered a setup where political parties are unable to use direct side payments to facilitate bargaining. If one allows such side payments then efficient bargaining leads to a regulation on the basis of a regulatory variable λ_{lr}^* that maximizes the common surplus $\hat{W}_{lr}(\lambda) \equiv \hat{W}_l(\lambda) + \hat{W}_h(\lambda)$. It is straightforward to see that the common surplus function is equivalent to twice the surplus function $\hat{W}_p(\lambda)$ that obtains from an individual party p with the weight $\lambda_p = (\lambda_l + \lambda_r)/2$. It is then immediate that $\lambda_{lr}^* = (\lambda_l + \lambda_r)/2$. Therefore, also with side payments political parties have an incentive to eliminate the regulatory risk that political uncertainty generates. The result is even stronger, because it is independent of whether the common surplus function $W_{lr}(\lambda)$ is concave or convex. It follows because, by Lemma 1, the common surplus function has a unique maximum. Yet, in the context of political economy, the assumption of efficient side payments seems inappropriate. For this reason the analysis concentrated on the case without transferable utility.

Appendix

Proof of Lemma 1: It follows

$$\hat{W}'_p(\lambda) = \frac{\partial \tilde{W}_p}{\partial x_h}(\hat{x}_h) \frac{\partial \hat{x}_h}{\partial \lambda}(\lambda).$$

From (5) it follows

$$v''(\hat{x}_h) \partial \hat{x}_h / \partial \lambda = -\psi \Delta c$$

so that, due to $v'' < 0$, we have $\partial \hat{x}_h / \partial \lambda > 0$. The sign of $\hat{W}'_p(\lambda)$, therefore, coincides with the sign of $\partial \tilde{W}_p / \partial x_h(\hat{x}_h)$. Note that

$$\frac{\partial \tilde{W}_p}{\partial x_h}(\hat{x}_h) = -\nu(1 - \lambda_p) \Delta c + (1 - \nu)(v'(\hat{x}_h) - c_h) = -\nu(1 - \lambda_p) \Delta c + (1 - \nu)(\psi \Delta c) = (\lambda_p - \lambda) \Delta c.$$

Hence, $\partial \tilde{W}_p / \partial x_h(\hat{x}_h)$ and, therefore, \hat{W}_p' is positive for $\lambda < \lambda_p$ and negative for $\lambda > \lambda_p$. This shows that $\hat{W}_p(\lambda)$ is increasing for $\lambda < \lambda_p$ and decreasing for $\lambda > \lambda_p$. Consequently, \hat{W}_p attains a unique maximum at λ_p . Because \hat{W}_p is twice differentiable it holds $\hat{W}_p'(\lambda_p) = 0$ and $\hat{W}_p''(\lambda_p) < 0$. Q.E.D.

Proof of Lemma 2: The function $\hat{W}_p(\lambda)$ is concave around λ if $\hat{W}_p(\lambda)$ is concave with respect to some interval $[\underline{\lambda}, \bar{\lambda}]$ around λ . A sufficient condition for this is that $\hat{W}_p''(\lambda) < 0$.

We have

$$\hat{W}_p(\lambda) = \nu[v(\hat{x}_l) - c_l \hat{x}_l - (1 - \lambda_p) \Delta c \hat{x}_h(\lambda)] + (1 - \nu)[v(\hat{x}_h(\lambda)) - c_h \hat{x}_h(\lambda)].$$

Using (5), differentiation of $W_p(\cdot)$ yields

$$\begin{aligned} \hat{W}_p'(\lambda) &= -\nu(1 - \lambda_p) \Delta c \hat{x}_h'(\lambda) + (1 - \nu)[v'(\hat{x}_h(\lambda)) - c_h] \hat{x}_h'(\lambda) \\ &= -\nu(1 - \lambda_p) \Delta c \hat{x}_h'(\lambda) + (1 - \nu)(1 - \lambda) \psi \Delta c \hat{x}_h'(\lambda). \end{aligned}$$

Using the definition of ψ , (6), and (7), a further differentiation of $W_p(\cdot)$ yields

$$\begin{aligned} \hat{W}_p''(\lambda) &= [-\nu(1 - \lambda_p) \Delta c \hat{x}_h''(\lambda) + (1 - \nu)(1 - \lambda) \psi \Delta c \hat{x}_h''(\lambda)] - (1 - \nu) \psi \Delta c \hat{x}_h'(\lambda) \\ &= (\lambda_p - \lambda) \nu \Delta c \hat{x}_h''(\lambda) - (1 - \nu) \psi \Delta c \hat{x}_h'(\lambda) \\ &= (1 - \nu) \left[(\lambda - \lambda_p) \psi \Delta c \frac{v'''(\hat{x}_h(\lambda))}{v''(\hat{x}_h(\lambda))} + v''(\hat{x}_h(\lambda)) \right] \hat{x}_h'(\lambda)^2. \end{aligned}$$

Hence, $\hat{W}_p''(\lambda) < 0$ exactly when

$$(\lambda_p - \lambda) \psi \Delta c v'''(\hat{x}_h(\lambda)) < [v''(\hat{x}_h(\lambda))]^2.$$

Q.E.D.

Proof of Proposition 1: For the special case where demand is convex ($v''' > 0$) it follows, for any $\lambda \in (\lambda_l, \lambda_r)$, that $(\lambda_l - \lambda) \psi \Delta c v'''(x) < 0 < (v''(x))^2$. Hence, inequality (10) is satisfied so that $\hat{W}_l(\lambda)$ is concave and, therefore, \tilde{W}_l^e is smaller than $\hat{W}_l(\alpha \lambda_r + (1 - \alpha) \lambda_l)$ for any $\alpha \in (0, 1)$.

For the special case where demand is concave ($v''' < 0$), it follows, for any $\lambda \in (\lambda_l, \lambda_r)$, that $(\lambda_r - \lambda) \psi \Delta c v'''(x) < 0 < (v''(x))^2$. Hence, inequality (10) is satisfied so that $\hat{W}_r(\lambda)$ is concave and, therefore, \tilde{W}_r^e is smaller than $\hat{W}_r(\alpha \lambda_r + (1 - \alpha) \lambda_l)$ for any $\alpha \in (0, 1)$.

For the linear demand case ($v''' = 0$), we have $\hat{x}_h^e = \hat{x}_h(\lambda_e)$. I showed that, for this case, both party r and party l dislike regulatory risk. Q.E.D.

Proof of Lemma 3: It follows

$$\begin{aligned}
W_r^e - \hat{W}_r(\lambda_e) &= \alpha \hat{W}_r(\lambda_r) + (1 - \alpha) \hat{W}_r(\lambda_l) - \hat{W}_r(\lambda_e) \\
&= \alpha \tilde{W}_r(\hat{x}_l, \hat{x}_h(\lambda_r)) + (1 - \alpha) \tilde{W}_r(\hat{x}_l, \hat{x}_h(\lambda_l)) - \tilde{W}_r(\hat{x}_l, \hat{x}_h(\lambda_e)) \\
&= \left[\alpha \tilde{W}_r(\hat{x}_l, \hat{x}_h(\lambda_r)) + (1 - \alpha) \tilde{W}_r(\hat{x}_l, \hat{x}_h(\lambda_l)) - \tilde{W}_r(\hat{x}_l, \hat{x}_h^e) \right] \\
&\quad + \left[\tilde{W}_r(\hat{x}_l, \hat{x}_h^e) - \tilde{W}_r(\hat{x}_l, \hat{x}_h(\lambda_e)) \right] \\
&= (1 - \nu) \left[\alpha v(x_h(\lambda_r)) + (1 - \alpha) v(x_h(\lambda_l)) - v(x_h^e) \right] \\
&\quad + \left[\tilde{W}_r(\hat{x}_l, \hat{x}_h^e) - \tilde{W}_r(\hat{x}_l, \hat{x}_h(\lambda_e)) \right].
\end{aligned}$$

Due to $v'' < 0$, the first term in squared brackets is negative. The second term in square brackets is non-positive, because $\hat{x}_h^e \leq x_h(\lambda_e) < \hat{x}_h(\lambda_r)$ and $\partial \tilde{W}_r / \partial x_h > 0$ for $x_h < x_h(\lambda_r)$ imply $\tilde{W}_r(\hat{x}_l, \hat{x}_h^e) \leq \tilde{W}_r(\hat{x}_l, \hat{x}_h(\lambda_e))$. As a result the overall expression is negative and, therefore, party r dislikes regulatory risk.

Similarly for party l , it follows

$$\begin{aligned}
W_l^e - \hat{W}_l(\lambda_e) &= (1 - \nu) \left[\alpha v(x_h(\lambda_r)) + (1 - \alpha) v(x_h(\lambda_l)) - v(x_h^e) \right] \\
&\quad + \left[\tilde{W}_l(\hat{x}_l, \hat{x}_h^e) - \tilde{W}_l(\hat{x}_l, \hat{x}_h(\lambda_e)) \right].
\end{aligned}$$

Due to $v'' < 0$, the first term in squared brackets is negative. The second term in square brackets is non-positive, because $\hat{x}_h^e \geq x_h(\lambda_e) > \hat{x}_h(\lambda_l)$ and $\partial \tilde{W}_l / \partial x_h < 0$ for $x_h < x_h(\lambda_l)$ imply $\tilde{W}_l(\hat{x}_l, \hat{x}_h^e) \leq \tilde{W}_l(\hat{x}_l, \hat{x}_h(\lambda_e))$. As a result the overall expression is negative and, therefore, party l dislikes regulatory risk. Q.E.D.

Proof of Proposition 2: If party l likes regulatory risk then, by Lemma 3, $\hat{x}_h^e < \hat{x}_h(\lambda_e)$, but party r then, by Lemma 3, dislikes regulatory risk. Similarly, if party r likes regulatory risk then, by Lemma 3, $\hat{x}_h^e > \hat{x}_h(\lambda_e)$, but party l then, by Lemma 3, dislikes regulatory risk. Hence, we cannot have that both parties like regulatory risk and if some party likes risk then the other party dislikes it. Q.E.D.

Proof of Proposition 3: We show that for $\Delta\lambda < \bar{\lambda}$ condition (10) is satisfied for any $\lambda \in (\lambda_l, \lambda_r)$ so that $\hat{W}_p(\lambda)$ is concave for the whole interval $[\lambda_l, \lambda_r]$.

Consider first party r : For any $\alpha \in (0, 1)$, it follows

$$\begin{aligned} (\lambda_r - \lambda_e)\psi\Delta cv'''(\hat{x}_h(\lambda_e)) &= (1 - \alpha)\Delta\lambda\psi\Delta cv'''(\hat{x}_h(\lambda)) \leq (1 - \alpha)\Delta\lambda\psi\Delta c|v'''(\hat{x}_h(\lambda))| \leq \\ \Delta\lambda\psi\Delta c|v'''(\hat{x}_h(\lambda))| &\leq \bar{\lambda}\psi\Delta c|v'''(\hat{x}_h(\lambda))| \leq \frac{(v''(\hat{x}_h(\lambda)))^2}{|v'''(\hat{x}_h(\lambda))|\psi\Delta c}\psi\Delta c|v'''(\hat{x}_h(\lambda))| = v''(\hat{x}_h(\lambda))^2. \end{aligned}$$

A similar result holds for party l : For any $\alpha \in (0, 1)$, it follows $0 < \lambda_l < \lambda_e < \lambda_r < 1$ and therefore

$$\begin{aligned} (\lambda_l - \lambda_e)\psi\Delta cv'''(\hat{x}_h(\lambda_e)) &= -\alpha\Delta\lambda\psi\Delta cv'''(\hat{x}_h(\lambda)) \leq |\alpha\Delta\lambda\psi\Delta cv'''(\hat{x}_h(\lambda))| = \\ \alpha\Delta\lambda\psi\Delta c|v'''(\hat{x}_h(\lambda))| &\leq \Delta\lambda\psi\Delta c|v'''(\hat{x}_h(\lambda))| \leq \\ \bar{\lambda}\psi\Delta c|v'''(\hat{x}_h(\lambda))| &\leq \frac{(v''(\hat{x}_h(\lambda)))^2}{|v'''(\hat{x}_h(\lambda))|\psi\Delta c}\psi\Delta c|v'''(\hat{x}_h(\lambda))| = v''(\hat{x}_h(\lambda))^2. \end{aligned}$$

Hence, for $\Delta\lambda < \bar{\lambda}$ both $\hat{W}_l(\lambda)$ and $\hat{W}_r(\lambda)$ are concave over the interval $[\lambda_l, \lambda_r]$. Q.E.D.

Proof of Proposition 4: First, suppose party l is a regulatory risk averse party. Because $W_r(\lambda_r) > W_r(\lambda_l)$, the expression $W_r^e(\alpha)$ is strictly decreasing in α and, in particular, $W_r^{e'}(1) < 0$. Moreover,

$$\left. \frac{d\hat{W}_r(\lambda_e(\alpha))}{d\alpha} \right|_{\alpha=1} = \left. \frac{\partial\hat{W}_r(\lambda_e(\alpha))}{\partial\lambda} \frac{\partial\lambda_e(\alpha)}{\partial\alpha} \right|_{\alpha=1} = \hat{W}_r'(\lambda_r)\lambda_e'(1) = 0,$$

because $\hat{W}_r'(\lambda_r) = 0$. Because $\hat{W}_r(\lambda_e(1)) = W_r^e(1)$, it then follows that $\hat{W}_r(\lambda_e(\alpha)) > W_r^e(\alpha)$ for $\alpha < 1$ but close enough to 1.

If party l is not a regulatory risk averse party, then, by Lemma 3, party r is regulatory risk averse. By a similar argument, one can then show that $d\hat{W}_l(\lambda_e(0))/d\alpha = 0$. Because $W_l^e(\alpha)$ is strictly increasing in α , it then follows that $\hat{W}_l(\lambda_e(\alpha)) > W_l^e(\alpha)$ for $\alpha > 0$ but close enough to 0. Q.E.D.

Proof of Proposition 5: Lemma 1 shows that \hat{W}_l is decreasing on $[\lambda_l, \lambda_r]$. Hence, $\hat{W}_l(\lambda) > \hat{W}_l(\lambda_l(\alpha)) = W_l^e$ if and only if $\lambda < \lambda_l(\alpha)$. Similarly, $\hat{W}_r(\lambda) > \hat{W}_r(\lambda_r(\alpha)) = W_r^e$ if and only if $\lambda > \lambda_r(\alpha)$, because \hat{W}_r is increasing on $[\lambda_l, \lambda_r]$. Hence, $\hat{W}_l(\lambda) > W_l^e$ and $\hat{W}_r(\lambda) > W_r^e$ if and only if $\lambda \in \Lambda(\alpha)$. Therefore, pre-electoral agreement is potentially beneficial if and only if $\Lambda(\alpha)$ is not empty which is equivalent to $\lambda_r(\alpha) < \lambda_l(\alpha)$. Q.E.D.

Proof of Proposition 6: Cooperation at λ^a is an equilibrium with the specified grim trigger strategies exactly when $W_p^c(\lambda^a) \geq W_p^d$ for both $p \in \{l, r\}$. It holds

$$W_p^c(\lambda^a) \geq W_p^d \Leftrightarrow \frac{\hat{W}_p(\lambda^a)}{1-\delta} \geq \hat{W}_p(\lambda_p) + \delta \frac{W_p^e}{1-\delta} \Leftrightarrow \hat{W}_p(\lambda^a) \geq (1-\delta)\hat{W}_p(\lambda_p) + \delta W_p^e. \quad (12)$$

Let

$$\bar{W}_p(\delta) \equiv (1-\delta)\hat{W}_p(\lambda_p) + \delta W_p^e$$

so that

$$\hat{W}_p(\bar{\lambda}_p(\delta)) = \bar{W}_p(\delta).$$

Because \hat{W}_l is decreasing on $[\lambda_l, \lambda_r]$, it follows that (12) with $p = l$ holds for any $\lambda^a \leq \bar{\lambda}_l(\delta)$. Likewise, (12) with $p = r$ holds for any $\lambda^a \geq \bar{\lambda}_r(\delta)$. Hence, cooperation is an equilibrium exactly when $\bar{\lambda}_r(\delta) \leq \lambda^a \leq \bar{\lambda}_l(\delta)$. Q.E.D.

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