Democracy, Crises, and Misconceptions

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Vorwort

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Hans-Jörg Beilharz

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Chapter 1

Introduction

A working democracy depends on the participation of people in the political and economic decision-making process. The knowledge required to make informed political decisions concerning an entire economy is enormous. This is especially the case for policy measures such as the introduction of general minimum wages affecting many sectors of an economy. Political economy and behavioral economics[1] have established that voters may lack knowledge about the mechanisms describing the interaction of markets in the economy. Consequently, democratic decisions may be inappropriate and hence may produce inefficient outcomes or even lead to economic crises.

We examine the consequences of voters' misconceptions and show how unemployment can be explained in an economy where voters do not take all general equilibrium repercussions into account when a binding minimum wage is introduced. Although the possibility of democratic failure is frequently doubted[2], we can justify this approach on several grounds.

Obviously political decisions are complex, whereas many single economic decisions are less difficult, e.g., a baker thinking about the price to ask for his bread. There is strong evidence in everyday life suggesting that agents are much more engaged in economic activities directly affecting their pockets and welfare than in policy affairs beyond their tangible experience. This does not mean that people do not have opinions concerning these issues. But they are rarely engaged in amassing enough knowledge to base fully rational opinion on. Furthermore, it is hard to believe that the crises affecting many European social states cannot be at least partially explained by insufficient economic knowledge on the part of the electorate and the agents of other democratic institutions. For example, Tabellini (2000) has identified the lack of knowledge among citizens

[1] See Chapter 2 "Conceptual Issues".

[2] This pessimistic view on the performance of democracy is sometimes rejected as an oversimplification ignoring the economic rational-choice paradigm. One advocate of democratic efficiency is Wittman (1995) "The Myth of Democratic Failure".

and conflicting interests among voter groups as the main reasons behind the delay of necessary reforms in European social states. Convictions about insufficient economic understanding are further strengthened by the fact that the economic environment for all industrialized countries has changed dramatically in the last few decades due to many complex structural changes.

After substantiating the possibility of democratic inefficiency, we will examine solutions counteracting detrimental policy persistence based on misconceptions. We investigate whether democratic institutions can provide all the necessary information enabling voters to make fully rational choices without requiring a complete understanding of the economy. This task is usually assigned to political parties running for governmental offices.[3]

Although political parties exist and operate by influencing public opinion the proposed solution may still be problematic in itself. One possible answer to this puzzle is that parties themselves may not be well informed about the functioning of the economy, either because the knowledge is genuinely not available or because parties are not able to adopt it for various reasons. Therefore parties may be subject to the same misconceptions as voters. Another eventuality is that parties may be well informed but either fail to or have no incentive to inform voters. Assuming that, at least after a while, there will always be some people who know how to solve an economic crisis in technical terms, we identify inefficient outcomes as a failure in political communication. It is the outcome of the interaction between rationally uninformed and risk-averse voters on the one hand, and political parties motivated by their partisans' interests and the desire for power on the other.

The thesis is organized as follows. In the next chapter (Chapter 2) we discuss the foundations for our models. We survey the theory of learning in macroeconomics and games and relate it to the model used in Part I dealing with the awareness of general equilibrium effects. We also relate the political economy of reform to the model of the voting game used in Part II.

In Part I (Awareness), we explain the emergence of a crisis in a democratic process in terms of inadequate patterns of thought (misconceptions). The crisis is a result of a "learning process" in which voters do not take into account all the general equilibrium effects caused by a minimum wage in a labor market.

In Part II (Policy Reversal), we discuss the potential reversal of a crisis. It is one possible result of a voting game between voters and parties in which parties signal the

[3]For example, see Art. 21 (1) of the German constitution, the Grundgesetz (1949) : "Die Parteien wirken bei der politischen Willensbildung des Volkes mit [Parties participate in forming people's political opinion]. ..."

correct view about the economy. We also discuss the conditions under which a crisis will persist.

Our findings support the intuitive and frequently voiced hypothesis that crises induce reforms. The findings rest on the supposition that crises can prompt agents to review their patterns of thought. They recognize that the crisis is caused by structurally misguided policies derived from an inadequate theory about the economy. Reform is the outcome of a political process in which an adequate theory is chosen instead of an inadequate one.

After discussion of the two models of potential democratic failure and success in Parts I and II, we advance some general conclusions in Chapter 11.

Chapter 2

Conceptual Issues

2.1 Learning Theory and Awareness

2.1.1 Learning Theory

2.1.1.1 Basic Ideas

In economics the problem of learning is typically studied within the framework of game theory and macroeconomic theory. In the following, we illustrate the principles of learning in macroeconomic terms.

A macroeconomic model usually consists of a vector of endogenous variables x, exogenous variables (shocks) y, parameters, and a probability distribution of shocks and parameters.

Learning theory deals with dynamic economic models in which the state of the economy at time t, x_t, depends additionally on agents' forecasts $x^e_{t,t-1}$ at time $t-1$ about the values of a subset of x_t. The reduced form of such a model is

$$x_t = F(x_{t-1}, x^e_{t,t-1}, y_t) \tag{2.1}$$

where

$$x_t \in \mathbb{R}^n \quad \text{and} \quad x^e_{t,t-1} \in \mathbb{R}^m, \quad m \leq n.$$

The vector y_t in equation (2.1) contains the values of exogenous shocks in t. The vector x_{t-1} may contain values of endogenous variables that go further back than $t-1$, and x_t may also depend on forecasts for more than one period in the future (expectational leads).[1]

As can be seen from equation (2.1), the dynamics of the economy depends on "forecasting rules" that transform all or part of the information available at $t-1$ into forecasts

[1] See Böhm and Wenzelburger (2004) for a discussion of models with expectational leads.

x_t^e. These rules are generated according to a "learning scheme" - a description of the process by which agents form their forecasts (expectations).[2] The evolution of the system involving expectation-formation under a learning scheme is called the learning process.

The natural benchmark or limiting point for any kind of expectation-formation is rational expectation as defined by Muth (1961). Rational expectations are mathematical conditional expectations where agents actually use the whole information available at time $t-1$. Furthermore, both the structure of the underlying economic model and the probability distribution of shocks and parameters are known to the agents.

A rational expectation equilibrium is an equilibrium generated by rational expectations.[3] It can be interpreted as the limiting point of a learning process where the agents' subjective probability distribution over the sequence $\{x_t\}$ converges to the actual (theoretical) probability distribution over $\{x_t\}$ according to the actual model, and the actual distribution of shocks and parameters. Clearly, depending on the available information, the model structure, and the learning scheme used, a learning process can, but does not have to, lead to a rational expectation equilibrium. It may converge to some other equilibrium or may not converge at all. Equilibrium in this context means that the decision rules depending on agents' forecasting rules do no longer change, i.e., the parameters of their decision function are constant over time.

We can now describe more precisely the questions learning theory deals with: Which learning scheme in which class of models under which conditions generates forecasting rules that converge to rational expectations? If they do not converge, what happens then? If there are multiple rational expectation equilibria, is there one that can be reasonably selected because it can be achieved by a "reasonable" learning scheme?

The last question goes right to the heart of economic theory as it concerns the economic concept of rationality. The question is what does "reasonable" mean?

Note that the assumptions made by rational expectations make considerable demands on agents. Not only do they have to know the true model of the economy and to gather all information available in principle, they also have to have the cognitive abilities enabling them to calculate optimal behavior. On these grounds, the standard assumption of full rationality (in the sense of rational expectations) frequently has to be defended as the outcome of a learning process in which agents - usually acting in an imperfectly rational manner - eventually reach an equilibrium as if they were acting in a

[2] A useful distinction between "learning scheme" and "forecasting rule" is made by Wenzelburger, see e.g. Wenzelburger (2002a). An example of a learning scheme is ordinary-least-squares estimation (OLS), where the forecasting rules are formed with the parameter estimates from data available at time $t-1$.

[3] The classical representation of an equilibrium in rational expectations is the Lucas supply curve.

fully rational manner, i.e., they achieve the rational expectation equilibrium. But even if one relaxes the assumption of full rationality and is willing to accept equilibria other than those with rational expectations, it is far from clear which form of rationality should be reasonably used in a given economic context. With respect to learning, this means that we have to discuss which learning schemes are appropriate, since they are influenced by the degree of rationality involved.

There are basically two concepts of how learning can be modeled. One approach is "educative" learning. In this approach, the reasoning process of agents is modeled explicitly, analyzing whether this reasoning process leads agents to coordinate on a rational expectation equilibrium. A game-theoretic example of an educative learning scheme is the iterated removal of strategies that are never a best response (rationalizable strategies).[4] Educative learning schemes are rather difficult to justify since they require considerable cognitive capacities from agents. A more realistic, and therefore much more frequently analyzed approach to learning is adaptive learning. "Adaptive" means that forecasting rules are adjusted when agents observe new data. One example of adaptive learning is Bayesian updating. In the next section, we will have a closer look at adaptive schemes.

2.1.1.2 Rational Learning and Boundedly Rational Learning

Definitions Learning requires that there is something to be learned. If agents have rational expectations as defined above, there is no need for learning. The literature distinguishes two classes of learning depending on the degree of rationality. There is rational learning and boundedly rational learning.

We define *rational learning* in the following way: Expectation-formation under rational learning is the same as under rational expectations, the only difference being that under rational learning the probability distribution of parameters and shocks is unknown to the agents. We need to consider two aspects here:

First, under rational learning agents behave in a totally rational manner under rational expectations. They use all the information available and have the necessary cognitive ability to compute mathematical conditional expectations. Therefore rational learning is Bayesian updating of an a-priori subjective probability distribution as soon as new data are observable. Especially in a game-theoretic context rational learning requires forward-looking behavior from agents. Therefore agents have to take into account future responses to their own actions by other players.[5]

[4] For an overview on educative learning, see Evans and Honkapohja (2001).

[5] Note that Nash equilibria can be interpreted as rational expectation equilibria, see e.g. Evans and Honkapohja (1999). In a rational expectation equilibrium actions by agents are best responses

Second, under rational learning agents know the true model structure. This point is not clearly defined in the literature. For example, Bray and Savin (1986) distinguish between rational learning where agents' "estimates are based on correctly specified models" and learning in a framework of bounded rationality, where this does not have to be the case. Hansen and Sargent (2001) consider model misspecifications policy-makers could be confronted with. Although the actual model is not known to the governing agency it knows the "benchmark model" of which the actual model is a "perturbation". We can say that here the concrete model structure is not known but the meta-structure of the model is. Schinkel, Tuinstra, and Vermeulen (2002) identify rational learning with Bayesian learning, i.e., in their view any learning scheme based on Bayesian updating is rational, independently of whether or not agents know the true model structure. For our purposes we will restrict the term "rational learning" to cases where the true model structure is known to agents. Otherwise one might ask: Why do agents within the model know less about the economy than the economist who builds the model? To answer this question one always has to assume that agents somehow have bounded knowledge relative to the model builder and hence, are boundedly rational.

Accordingly, we define *boundedly rational learning* as any kind of learning that is not rational learning. For example, learning with a misspecified model structure or with a learning scheme that does not use all available information is boundedly rational.

Rational Learning As follows from our definition above, the learning scheme of rational learning is Bayesian updating. The work on rational learning was pioneered by Townsend (1978), who studied this type of learning in the framework of a cobweb model and found convergence to a rational expectation equilibrium.

Starting from a model of information extraction from asset prices, Bray and Kreps (1987) find that agents' subjective probability distributions of parameters with correctly specified priors converge "almost surely" to the true probability distributions of parameters for any model of rational learning. They derive this finding from assumptions that are not very restrictive and call it "convergence of beliefs". Unfortunately, convergence to a rational expectation equilibrium cannot be assured. This is due to the self-referential nature of the learning process and the possibility of multiple equilibria. Self-referential means that the agents' expectation-formation influences the path of the economy in a way that would not be influenced by an outside observer estimating

according to their rational expectations. Here each agent has to take into account the fact that all other agents also have rational expectations. In such an equilibrium we therefore have mutually consistent actions and beliefs, such that subjective probability distributions over outcomes equal the true probability distributions over outcomes.

a rational expectation equilibrium. The outside observer only observes the states of the economy; his expectations do not influence the development of the system as he does not make any decisions within the system based on his forecasts. The crucial point in Bray and Kreps' analysis is that agents know the correct model, i.e., they learn "within" a rational expectation equilibrium. When the agents' model structure is misspecified, Bayesian updating may not even lead to a convergence of beliefs.

In game theory, models of rational learning can be used to justify the concept of Nash equilibrium since they explicitly model the way in which agents can learn Nash equilibrium strategies, i.e., the rational expectation equilibrium. Kalai and Lehrer (1993) analyze infinitely repeated games with incomplete information, where the payoff functions of a player's opponents do not have to be known to that player. If subjective priors of players contain a "grain of truth", i.e., if players do not assign zero probability to events that "can occur in the playing of the game", the strategies actually played by the players converge to a "subjective equilibrium". Fudenberg and Levine (1993) arrive at what is basically the same equilibrium concept without explicitly modeling a learning process and call it a "self-confirming equilibrium". In a self-confirming equilibrium the players' beliefs have to be consistent on the equilibrium path, though they may differ off the equilibrium path. Intuitively, in a self-confirming equilibrium players will never learn that they hold erroneous beliefs off the equilibrium path since they never observe the actions of opponents contradicting their beliefs. Therefore every Nash equilibrium is a self-confirming equilibrium but not every self-confirming equilibrium is a Nash equilibrium.

In summary, although in many concrete macroeconomic or game-theoretic models, the convergence of rational learning to a rational expectation equilibrium can be shown to exist, general convergence results are difficult to establish.

Boundedly Rational Learning In the following, we give an overview of boundedly rational learning schemes. The most commonly applied schemes in literature are adaptive.

One of the earliest theories about expectation-formation is the so-called "adaptive expectations" hypothesis. Agents form their expectations by adding to the last period's expectation a fraction of the last period's forecasting error (see e.g. Cagan (1956)). Another form of adaptive learning scheme often drawn upon in the early literature is "static expectations". Under static expectations agents assume that a variable's realization tomorrow equals its realization today. Famous examples are models of the Phillips curve where it is assumed that agents will expect tomorrow's inflation rate to be the same as today's. Since this procedure is very simple, it is not implausible to assume that people actually behave in this way, although there is no reason to assume that static expectations will generally lead to a rational expectation equilibrium. Obviously the same holds for adaptive expectations.

In more recent literature, a frequently used and thoroughly analyzed approach to learning in a macroeconomic context is ordinary-least-squares estimation (OLS), see e.g. Sargent (1993). It is assumed that agents behave like econometricians and estimate the model's parameters by OLS from observable data in the past. For linear models, Evans and Honkapohja (2001) provide many convergence results to rational expectation equilibria under OLS learning. In this adaptive learning approach there are two sources of bounded rationality.

First, if there is prior information about the distribution of parameter values Bayesian estimation is more precise. In that case OLS does not use all the available information and is therefore boundedly rational.[6]

Second, it is usually assumed that agents specify their model as if they were in a rational expectation equilibrium although this is not the case as there is learning involved. They know the correct model structure of the equilibrium but they do not know the true parameter values and have to learn them by OLS. Because the learning process is self-referential, their parameter estimates will vary over time, while they assume the constant parameter values corresponding to a rational expectation equilibrium. Consequently, they estimate a misspecified model. Nevertheless, there are several justifications for this approach. One is that real econometricians actually work in this fashion. Furthermore, even if agents took into account time-varying parameters, they would still need additional information that is usually not available (see Bray and Savin (1986)). And last but not least, convergence to rational expectations can be shown in many models in spite of the misspecification.

A more general approach to learning is proposed by Böhm and Wenzelburger (1999) and Wenzelburger (2002a). They analyze the conditions under which "perfect predictors" exist for variables in an "economic law" with "expectations feedback". Perfect predictors are forecasting rules that converge to rational expectations. Instead of deriving convergence results for a given learning scheme, e.g. OLS, they examine whether perfect predictors exist independently of a learning scheme for a given economic law (model), especially in the case of non-linear models. For one-dimensional models of the Cobweb type, e.g. a standard OLG model, Wenzelburger (2002b) provides an adaptive learning scheme that generates forecasting rules converging to rational expectations. For this purpose, Wenzelburger draws on the concept of an error function (historical forecasting errors) that contains all the necessary knowledge concerning the underly-

[6] For a detailed comparison between Bayesian estimation and OLS, see Greene (1993).

ing economic problem. The error function is defined independently of the forecasting rule or learning scheme used. Interestingly, the exact functional form describing the economy does not have to be known in order to use this function.

The same holds for learning through neural networks, another approach to bounded rational learning.[7] Neural networks are computational systems built in analogy to biological structures in the nervous system of humans and more highly developed animals. A neural network consists of nodes - called neurons - and connections between nodes. A neural network can be very complex but it can be broken down to its basic modules - perceptrons - which are sub-networks of the whole system. In a perceptron, the incoming information is transmitted from input nodes to a receiving output node which transforms the input signals into an output signal. The transformation is made via an algorithm connecting the incoming signals from the input nodes. The perceptrons themselves are connected with each other, such that the output nodes can be input nodes for the following perceptrons. A neural network "learns" by training with a fixed data set. The training consists of altering the weights of connections between input and output nodes in such a way that the output signals fit in well with the corresponding values of the training set.[8]

One advantage of neural networks is that they are very good at approximating unknown functions, especially when they are trained repeatedly with new sets of data. Therefore they are useful tools for modeling learning when the model specification is unknown.[9]

Furthermore, even if they are trained on only one special problem, they can be used to solve other similar problems, e.g. learning the Nash equilibria of similar games (see Sgroi and Zizzo (2002)), albeit with a lower degree of success than in the original game. Therefore this feature is very close to actual human behavior. As Sgroi (2004) points out, it is precisely because of its limitations that it is so close to human behavior.

Another limitation is that neural networks tend to provide only locally optimal solutions. This feature can be interpreted as "satisficing" behavior, a term introduced by Simon (1956) . Satisficing behavior means that humans choose alternatives according to some specified criteria, but those criteria do not have to be either unique or optimal in the sense of full rationality. Because of bounded cognitive capabilities and

[7] Neural networks belong to the framework of artificial intelligence. Further examples are classifier systems or genetic algorithms. For an overview, see Evans and Honkapohja (2001).

[8] A frequently used numerical learning algorithm is back-propagation. The weights of neural connections are altered so that an error function is minimized. The weights are adjusted according to the error functions gradient.

[9] In the context of modeling bounded rationality in macroeconomics, Salmon (1995) provides a comparison between Bayesian learning and OLS learning, on the one hand, and learning by neural networks on the other.

bounded resources, humans end their choice procedure when they find an alternative that is "good enough". Both characteristics - satisficing choices and limited similar problem-solving - make neural network learning appealing by endogenizing bounded rationality in human behavior.[10]

In game theory, both models of rational learning and models of bounded rational learning are used to justify and refine the concept of a Nash equilibrium. In the following we present the three basic models of boundedly rational learning. They are thoroughly discussed and exemplified in Fudenberg and Levine (1998). Their common feature is that a stage game is played repeatedly, and agents try to learn the strategies of their opponents in order to respond optimally. There are many matching and revelation settings conceivable. In a fixed-player model, the same players always play against each other. In large population settings, one pair of players or all players can be matched randomly, with agents either observing only the results of their own actions or the aggregate actions and payoff statistics of all agents.

Partial best-response dynamic and *fictitious play* are usually analyzed in a fixed-player setting. Agents build beliefs about their opponents' strategies by observing their historical actions. Players behave in a boundedly rational way in that they only optimize the current period's subjective expected payoff, i.e., they are myopic. They play best responses to their beliefs without considering the influence their current actions may have on the future play of other agents.

In the partial best-response dynamic, agents base their decisions on their opponents' strategies from the last period only. One interpretation is that they have limited memory, since they behave as if they had forgotten any actions that took place more than one period before. An example for a partial best-response dynamic is the Cournot adjustment process.

In fictitious play, each player learns his opponents' mixed strategy profile by observing the historical frequency of any pure strategy combination in the stage game. In other words, the agents' probability assessment that opponents will play a given strategy profile corresponds to the relative frequency with which this strategy profile has been played in the past. According to this assessment, the agent plays a best response in pure strategies. One can interpret agents' behavior as boundedly rational since they always assume that opponents follow a stationary strategy, which, of course, does not have to be the case.

The third class of models is evolutionary and is frequently represented by the *replicator*

[10]The modeling of bounded rational behavior through neural networks is carried out e.g. by Cho and Sargent (1996) in a repeated play of the Prisoner's Dilemma game and by Salmon (1995) in a macroeconomic model of monetary policy and inflation surprise.

dynamics model. It is based on analogy to the biological concept of evolution but can be applied in economic contexts as well.

In the standard replicator dynamic there is a homogeneous population with identical agents, each of them playing one pure strategy from the same set of strategies. In each round all agents are matched randomly pairwise and play the same stage game. Players are genetically programmed to invariably play one strategy only. Therefore one can identify the players with their strategies. The fraction of agents playing a certain strategy, i.e., the fraction of a "phenotype," can be interpreted as the probability with which the corresponding pure strategy is played in a mixed-strategy profile of the stage game. The population as a whole learns through replicator dynamics. The net reproduction rate of each phenotype is proportional to the success of its strategy. Success is measured as the deviation of a phenotype's expected payoff from the average expected payoff of the whole population. Hence the fraction of a phenotype with higher than average payoff increases, while the fraction of a phenotype with lower than average payoff decreases.[11] It can be shown that every stable steady state of the replicator dynamic is a Nash equilibrium (see Fudenberg and Levine (1998)). In a steady state, each phenotype's net reproduction rate is zero, i.e., all agents have the same expected payoff. It is stable if a small perturbation from the fractions of phenotypes representing a Nash equilibrium converges back to the Nash equilibrium. Unfortunately, the dynamic may not always converge to a steady state, but if it does, it provides a refinement to the concept of a Nash equilibrium. At the individual level, agents do not behave strategically. They do not consider the fact that their current actions may influence future play, nor do they assume that their opponents will behave in an optimizing manner. Nevertheless, the Nash equilibrium can be learned by the population without this knowledge at the individual level.

There are two psychological learning concepts justifying the use of replicator dynamics to model real economic behavior. Both concepts rest on agents' bounded rationality. Agents only have to know which strategy is more successful, they do not have to know why it is successful, i.e., they do not have to know the whole range of strategies employed by all the other players and the payoffs they obtain (see Holler and Illing (2000)).

One central concept here is that of "social learning." Agents ask other agents about their strategies and payoffs and imitate those strategies if they are more successful than their own. Consequently, more successful strategies are adopted by a growing number of agents, while less successful strategies are used by a declining number.

[11]Instead of a homogeneous population there are settings with more than one population. In such heterogenous population models, the size of each population remains constant, and changes in the fractions of strategies occur within the populations.

The other central concept is that of stimulus and response. Here, an agent will try different strategies in different rounds, i.e., he plays a (non-stationary) mixed strategy over time. Pure strategies resulting in higher payoffs are reinforced. Accordingly, "better" strategies are played with a higher probability in the subsequent periods.

In sum, replicator dynamics can be used to justify the Nash equilibrium concept in the presence of boundedly rational agents. A rational expectation equilibrium in the form of a Nash equilibrium can be achieved by a learning process without the assumption of unbounded rationality. Moreover, it provides an interpretation of a Nash equilibrium that does not require individual agents to play mixed strategies, which is advantageous in view of the fact that it is doubtful whether agents use mixed strategies in reality (see Rubinstein (1991)).

Behavioral Aspects of Boundedly Rational Learning A major shortcoming of bounded rational learning models is that learning schemes are frequently introduced arbitrarily. Assuming bounded rationality may be closer to actual human behavior, but there is usually no explicit model of why agents use one scheme rather than another. The learning scheme is assumed rather than explained.

Approaches to endogenizing the problem of learning can be found in behavioral economics. As with rational learning, there is no clear definition of what behavioral economics is. In fact, it is much less clear than the definition of rational learning, and there is a broad range of literature that could be classified accordingly. For our purposes, we will define behavioral economics as the modeling of bounded rationality via explicit consideration of psychological, environmental, or empirically founded deviations from complete rationality in individual human behavior.[12]

We assume that bounded rationality is any behavior that departs from the classical economic definition of unbounded (full) rationality but is still compatible with the everyday definition of rationality. In other words, it is "appropriate" as far as possible, and it is not irrational in the sense of impulsiveness or mental illness, etc. Nevertheless, it may not be fully logical, e.g., in the sense of subjective expected utility theory.

The main features of the classical assumption concerning full rationality can be found e.g. in Rubinstein (1998), p. 8: The completely rational decision-maker has full knowledge of the problem (e.g. knows all alternatives), clearly defined preferences, unlimited abilities to optimize any choice function, and is indifferent concerning logically equivalent descriptions of alternatives.

In considering deviation backgrounds, behavioral economics can also be interpreted as

[12]For a survey of behavioral economics see Simon (1997), Part IV.

a microeconomic foundation for learning and other economic decision problems. In the last section, we described two examples of psychological foundation in the context of replicator dynamics: social learning through imitation and stimulus-response learning through reinforcement.

Many of these types of phenomenon may be applicable to economic behavior and can be used to specify a "reasonable" learning scheme in a given economic context.

The pioneer introducing the idea of bounded rationality in economics was Herbert Simon.[13] Within his concept of bounded rationality he distinguishes substantive and procedural rationality (Simon (1976)). Substantive rationality is the kind of behavior that leads to the achievement of a specified goal in the presence of given constraints. If we combine substantive rationality with the goal of utility maximization and unbounded computational capabilities, we obtain the classical concept of optimization (Salmon (1995)). In contrast to this, procedural rationality indicates a process consisting of some reasonable deliberation strategy. The concept of procedural rationality suggests that the results of real-life economic decisions can be analyzed more appropriately by focusing on the process of decision-making itself, instead of assuming that substantive rational agents somehow behave "as if" they were achieving a strictly specified goal. Procedurally rational agents follow an explicitly modeled decision procedure with outcomes that might be "only" satisficing (see paragraph "Boundedly Rational Learning", p. 10) but not necessarily optimal, e.g. in the sense of unbounded rationality. Therefore the knowledge gained by analyzing the actions of procedurally rational agents may reveal much more about the actual learning behavior of boundedly rational agents than the analysis of substantive rationality.

One attempt to model procedural rationality is the concept of the "adaptive toolbox" summarized in a collection of articles edited by Gigerenzer and Selten (2001).[14]

The adaptive toolbox consists of three elements: search rules, stopping rules, and decision rules. Each element represents one stage in a process that finally leads to an

[13]Much of his work in this field is to be found in Simon (1982).

[14]In contrast to our definition, Gigerenzer (2003) sees the adaptive toolbox as belonging solely to the concept of bounded rationality and not to behavioral economics. In Gigerenzer's view, behavioral economics does not deal with procedural issues but with deviations in some forms of substantive rationality from the substantive rationality of fully rational agents, where the deviations are due to "systematic errors in judgment and decision-making" (see Gigerenzer (2003), p. 11). Behavioral economics would not belong to bounded rationality since optimizing in a mathematical sense would still be assumed. We see it the other way round and consider the concept of bounded rationality as belonging to behavioral economics and also count deviations of substantive rationality from unbounded substantive rationality as belonging to bounded rationality. In our opinion, even if some forms of substantive rationality may model the decision process unrealistically they still consider deviations from full rationality are founded in empirical or experimental evidence. Therefore they can be clearly distinguished from ad-hoc assumptions of bounded rationality as in Sargent's modeling of agents as econometricians.

economic decision. The crucial point is that in each step agents use "fast and frugal" [15] heuristics instead of mathematically consistent procedures.

In real life, the total set of alternatives is rarely known. Therefore the first step consists in a search for alternatives. Furthermore, if we recognize that it is often impossible to obtain knowledge of all the existing alternatives (e.g. knowledge of all second-hand cars on the used-car market in a large city) heuristics like random search or some form of ordered search (e.g. according to the size of second-hand car dealers) are certainly "rational" from a practical viewpoint.

The same applies to step two in the adaptive toolbox, the application of stopping rules. One heuristic may be to stop searching if one has found an alternative whose value is at least as high as an aspiration level. This strategy would correspond to Simon's satisficing behavior. The stopping rule is required to avoid exorbitant searching costs. Furthermore, it has to be simple in order to avoid exorbitant computations in optimizing a complex cost-benefit function for the search.

Finally one needs decision rules, which are the kind of rule most commonly analyzed. A frequently used decision heuristic is the application of cues. The choice in favor of an alternative depends on a number of characteristics with which alternatives are compared. One cue in the used-car example might be the age of the car together with the decision rule "take the newest."

In his book "Modeling Bounded Rationality", Rubinstein (1998) formalizes ideas describing the way real agents' behavior deviates from unbounded rationality. He identifies three experimentally well-analyzed psychological phenomena giving rise to many such deviations. First he discusses the framing effect, i.e., the fact that human decisions may depend on the way the problem is presented. For example, it may make a difference whether a tax reduction is presented as a gain or as a smaller loss for tax payers. Second, we have the tendency to simplify decision problems. This phenomenon obviously strengthens Gigerenzer and Selten's argument that agents usually use heuristics to solve their economic problems. Third, the choice function may depend on which elements there are in the set of alternatives, i.e., the preference for one alternative to another may be altered if the set of alternatives changes.

Kahneman, Slovic, and Tversky (1982) focus on behavioral aspects of decision-making under uncertainty by analyzing the assessment of subjective probabilities. In this framework they analyze the representativeness heuristic where agents assign events higher or lower probability depending on the extent to which they represent the problem in question. They find that once probability has been assigned, people are conser-

[15] See Gigerenzer and Selten (2001), p. 174: "Fast refers to the relative ease of computation... . Frugal refers to the very limited amount of information these strategies need."

vative in updating their assessments (beliefs) when new observations are made. Agents need more than one observation indicating the necessity of a new assessment before they will actually alter their original belief to accord with the new observations.

If we apply this empirical observation to our context (finding reasonable learning schemes), we may alter, say, OLS learning to the extent that expectation-adaptation through regression is made less frequently and expectations are held constant in the meantime.

Kahneman et. al. also discuss how heuristics that are doing well can be learned from experience. They emphasize that learning is essentially inductive rather than deductive.

One implication of this observation is that the framing of the problem rather than its logical structure determines which heuristic is chosen. People learn with respect to the subject and not to the logical structure of the problem. For example, people may use the same heuristic in two different economic environments because in both they have to decide about a tax burden. On the other hand, they may use two different heuristics for the same economic environment because they have to decide about two subjects, a tax burden and the provision of a public good. And they will use these two different heuristics although both problems may be the same in structural terms.

A further implication of the inductive nature of learning is the importance of feedback effects. The more positive the experience with a heuristic has been, the more likely it is to be applied in future, i.e., a heuristic that does well is reinforced.

There is a broad range of literature where the basic behavioral ideas discussed so far have been applied explicitly to model learning as a process of procedural rationality.

Slembeck (2000) criticizes evolutionary learning models for neglecting the learning capacities of individual agents and only analyzing learning at the population level. He proposes breaking down learning to its component parts and calls his program "bedingtes Lernen" [conditional learning]. Elements of conditional learning are the consideration of the number of alternatives, interactions between agents, the availability of information, and the quantity and quality of feedback.

Brenner (1996) models "learning in a repeated decision process" and identifies four important features of learning. First, many changes in behavior that can be interpreted as learning are due to random variation in behavior. Second, imitation is a biologically and psychologically well-established learning strategy. Third, he identifies conservatism to the extent that people are sluggish and tend to repeat former strategies again and again until very negative feedbacks urge them to change their behavior. And fourth, learning depends strongly on experience with certain strategies in the past.

Another strand of the literature, represented by Thaler (1999), Mullainathan and Thaler (2000), or Barberis and Thaler (2002), mainly analyzes departures from unbounded substantive rationality in the field of financial economics. Apart from bounded rationality, Mullainathan and Thaler (2000) name “bounded will-power” and “bounded selfishness” as further restrictions to classical economic theory. This literature identifies psychologically well-founded deviations from full substantive rationality that we will consider in the next section.

2.1.2 Relation to the Awareness of General Equilibrium Effects

In this section we intend to relate our discussion of learning, bounded rationality, and behavioral economics to the possibility of misguided policies caused by inappropriate patterns of thought. Inappropriate here means that voters neglect general equilibrium effects stemming from minimum wages implemented in one sector of the economy. This can also be interpreted as an inappropriate learning scheme in that it does not lead to a rational expectation equilibrium. The learning process itself and the results will be discussed in detail in Part I “Awareness”. In the following, we merely outline the basic framework of that model.

Suppose there is a two-sector economy with three labor markets exhibiting inelastic labor supply. Workers are immobile across labor markets. In sector 1, we have two labor markets, one for high-skilled and one for low-skilled workers. In sector 2, we have a homogeneous labor force. In a majoritarian democratic voting process, where each worker in each sector has one vote, workers have to decide upon the level of a minimum wage for the low-skilled workers in sector 1. We assume that no group has a majority of its own while each combination of two groups has a majority of over fifty percent of the total votes. If unemployment occurs in the regulated labor market, the unemployed low-skilled workers obtain a fixed fraction of the employed low-skilled workers’ nominal wage as unemployment benefit. The benefits are financed by a payroll tax on the nominal wage of each worker in each sector.

To decide which level of the minimum wage they want to vote for, workers have to form expectations about the state of the economy connected with a minimum wage, i.e., they have to form expectations about their utility level depending on the minimum wage. They vote accordingly. Therefore, the minimum wage actually implemented and the state of the economy actually reached after voting depends on the expectations of voter groups.

When the agents make their forecasts, we will assume that they only consider the direct effects caused by a certain minimum wage level. They only consider the direct effects in sector 1 and neglect general equilibrium repercussions on sector 2 and on macroeconomic variables. Therefore they assume that both prices and wages in sector 2 will remain constant as well as the tax rate with which unemployment is financed.

This behavior corresponds to a mixed learning scheme. On the one hand, we have a boundedly rational learning scheme concerning the variables of sector 2 and the tax rate. To put it more concretely, agents follow static expectations in that they expect that the nominal price level in sector 2, the nominal wage level in this sector, and the tax rate will remain constant after voting has taken place, independently of the minimum wage level implemented. After the new minimum wage has been implemented, workers observe the new price and wage levels in sector 2 and the new tax rate. Although their static expectations are not confirmed, they take the new values and assume once again that they will not change if a new minimum wage is set in the period after elections. Nevertheless, we have completely rational learning concerning all other variables. According to our definition, the learning process as a whole is boundedly rational, since not all expectations are completely rational.

The question is whether this compound learning scheme based partly on boundedly rational expectations will lead to a learning process that converges to a rational expectation equilibrium. As will be discussed in detail in Part I, if agents had completely rational expectations the high-skilled workers in sector 1 and the workers in sector 2 would always vote for the market-clearing wage as the minimum wage for the low-skilled workers in sector 1. As two worker groups always form a majority of voters, we can identify the free-market solution as a rational expectation equilibrium in the political process. But as we will see, the learning process in most cases does not lead to the free-market solution, since under the specified learning scheme at least two voter groups would always vote for a minimum wage that is the highest one possible in their view.[16]

As a result, a crisis will occur in the long-run, since unemployment among the low-skilled workers will rise dramatically and the real wages of the high-skilled workers and workers in sector 2 will decline significantly.

In the literature on political economics it has been well established that voters are frequently not fully rational in their assessments of the economic consequences of policy measures. According to Saint-Paul (2000b), the assumption of unbounded rationality is even more questionable in economic policy than in standard economic theory

[16]The actual path of the learning process depends on whether agents clear the first or the second goods market in their minds when forming their expectations.

where only single issues are usually considered. An important reason for bounded rationality in political economics is that voters need to know a general economic theory embracing not only many single economic problems but also the interaction between economics and politics. Therefore learning within a misspecified model should always be considered when looking for reasons for policy failures.[17]

To explain the learning scheme in our two-sector model we have to take into account two levels of bounded rationality. The first level is the non-awareness of general equilibrium repercussions from one sector to the other. The second (level) is the non-awareness of expectation errors over time, i.e., we have to explain why agents do not reconsider their expectation-formation when their forecasts about the consequences of a higher minimum wage are not confirmed.

With reference to non-awareness of general equilibrium effects, Saint-Paul (2000b) observes that voters "base their decision much more on the direct impact of the proposed policy on their welfare than on its general equilibrium effects, which are much more difficult to evaluate" (p. 919). The same kind of "misconception" is discussed in a paper by Romer (2003), who analyzes the effects of voting decisions when voters individually obtain misleading but correlated signals about the outcome of a certain policy. The neglect of general equilibrium effects is also discussed in papers by Gersbach and Schniewind. For example, Gersbach and Schniewind (2001) model a two-sector economy where labor unions and employers are not fully aware of all equilibrium effects in their wage bargaining. Kinder and Mebane (1983) find empirical evidence that most American voters tend to judge political decisions in isolation. For example, in judging changes in tax rates they only see the changes themselves but do not inquire whether these changes may be or may not be in accordance with the principles of the tax system. Obviously, at least the tax system as a whole should be considered if one wants to assess all the general equilibrium effects of a change in tax rates. Furthermore, some behavioral observations presented in the previous section show that non-awareness may play a role in voters' decision-making. One point is the fact that people tend to simplify decision problems. This may lead to the use of over-simplified heuristics resulting in myopia. Other features are framing effects and the habit of judging a problem with respect to the sphere it belongs to and not with respect to its logical structure.

Nevertheless, even if one concedes non-awareness of general equilibrium effects, we

[17]The problem of model misspecification is central to the closely related literature on "temporary equilibrium". For both learning and temporary equilibrium, expectation-formation is crucial. But in contrast to learning, the notion of temporary equilibrium focuses more on the states of the economy reached over time, while the literature on learning usually focuses on the state the economy finally converges to. For example, see Grandmont (1988) for an overview, or Grandmont (1998) on "self-fulfilling expectations in socioeconomic systems."

still need a justification for why people do not change their learning scheme once they have realized that their forecasts are not accurate. There is strong evidence that once people have formed an opinion they will maintain it for as long as possible. Barberis and Thaler (2002) identify two behavioral effects supporting this. "Belief perseverance" induces agents to refrain from searching for new evidence and adhering to an established opinion even if they observe evidence to the contrary. An even stronger psychological phenomenon is "confirmation bias". People with confirmation bias not only ignore contrary evidence they even interpret that evidence as supporting their original hypothesis. This is in accordance with Kahneman, Slovic, and Tversky (1982), who observe that agents are conservative in updating their beliefs, or with Brenner (1996), who observes that people are sluggish and only change their behavior when feedback is extremely negative (see previous section). In our context, this sluggishness may be supported by the fact that people do not know whether erroneous expectations are due to their own misconceptions or due to exogenous effects on the economy. For example, when unemployment is higher than expected, agents may presume that this is due to poor economic performance in other countries, leading to a fall in exports. They may not consider the fact that they have neglected general equilibrium effects. A further clue for conservatism or sluggishness is adduced by Kinder and Mebane (1983) in their inquiry on how people build their theories about the economy. They observe that agents judge new political problems in terms of a mental framework they have used so far. When new events come up, they first try to interpret them within their existing judgmental scheme, which is only gradually adapted to new circumstances.

2.2 Signaling and the Political Economy of Reform through Crises

In Part II (Policy Reversal) we argue that crises can prompt agents to review their patterns of thought concerning the economy. As a result, agents will revise misguided economic views making it possible to overcome crises.[18] This argument on how crises induce reforms is complementary to others that can be found in literature and are summarized by Drazen (2000).[19]

One proposal that has been advanced is that crises are needed to overcome the selfishness of powerful interest groups harming the welfare of society as a whole.[20] For

[18]One example of a change in economic views is the move from a more Keynesian to a neo-classical perspective more than 30 years ago.

[19]Drazen and Easterly (2001) test the hypothesis that crises induce reform with samples from over 120 countries and about 30 years. They find evidence for this assumption when economic conditions have deteriorated heavily, as indicated by extreme inflation values and black-market premium.

[20]The fact that the power of interest groups can have detrimental effects on the economy as a whole

example, Bernholz (2000) explains the power of interest groups by the existence of rationally uninformed voters. Only when the crisis is severe enough will voters recognize the detrimental role of interest groups and the government be forced to employ a log-rolling agreement between these groups to improve the welfare of the majority of voters.

Another line of argument rests on the ex-ante uncertainty of voters about who are the losers and winners of reform. Although a reform is beneficial ex-post for a majority of voters, it may not be adopted ex-ante because a majority of voters have negative expected utility with respect to the post-reform environment. Vice versa, a reform may be adopted although a majority is harmed ex-post. The reform may be reversed because the majority believe that they will benefit from reversal. Collecting these two effects we obtain what Fernandez and Rodrik (1991) call “status quo bias”.[21]

Our approach - a change in agents' point of view leading to reform and triggered by a crisis - can be modeled in different ways. One way would be to model the process of change as a learning process leading to the correct view. A starting point for such an approach might be the discussion by Hansen and Sargent (2001) about model misspecifications policy-makers are confronted with in a learning process (see Section 2.1.1.2 “Rational Learning and Boundedly Rational Learning”).

We intend to describe the change as the overcoming of communication shortcomings between voters and parties. In a signaling game, the crisis can be reversed if the governing party communicates the correct view to voters.

In our model, there are two parties that run for office, the incumbent and the challenger. In the political sphere, two views about the functioning of the economy exist and can be proposed by parties together with a corresponding policy measure. The success of this measure depends on which view correctly describes the functioning of the economy. The crisis has developed and persists, because so far policy measures have been based on an incorrect “old” view. Policy measures based on the “new” correct view would lead out of the crisis. The problem is that neither parties nor voters can verify without efforts what the correct view out of the two alternatives is.

We assume that agents do not necessarily deduce from the occurrence of a crisis to an erroneous chosen policy since the economy appears too complex to analyze. This assumption is supported by a variety of literature. For example, Rodrik (1996) identifies “collective irrationality” as an important source of policy persistence leading

is well established, see e.g. Coate and Morris (1999), Olson (1982, 1995), or Rodrik (1993).

[21] In a similar model by Lában and Sturzenegger (1994), an ex-post socially beneficial reform only takes place when the severity of status quo conditions outweighs the uncertainty of voters about the post-reform environment.

to crises. Reform is delayed and detrimental policies persist because of "technical uncertainty" about correct measures, not only on the part of the common people but also on the part of governmental institutions. According to Saint-Paul (1996b), uncertainty concerning the correct theory about the economy can even be found among economists. Therefore there appears to be a strong connection between crises as a result of bounded rationality (old view) and reform as a result of a switch to full rationality (new view). In particular, the observation that policy is detrimental may take time, since the effects of policy measures can frequently only be established ex-post via econometric time-series analysis.

Nevertheless, we assume that the party in office can find out what the correct view is because it has the governmental resources to do so. Only it has to incur information costs. In contrast, voters and the opposition party never have the capabilities to find the appropriate theory of the economy. Therefore, the challenging party adheres to the old view, and voters have to rely on the governing party signaling credibly what the correct policy is.[22]

A proposal's credibility - or the probability from the voters' standpoint that the party has revealed the correct view - may be low because the incumbent party may want to avoid information costs. Furthermore, the party's policy proposal may be driven by partisan concerns.

In our analysis, we will identify two features which support the revelation of the correct view. Firstly, the governing party reveals the correct view if it is mainly driven by office concerns, i.e., it behaves "opportunistically". In this case, it just proposes the policy the risk-averse voter approves with certainty. It is a small reform proposal of the correct view which is less risky for voters since policy measures in accordance with the old view are quite extensive. Secondly, the policy proposals are so large that the party only can assure reelection if it informs with high probability and thus makes its proposal very credible. In contrast, cautious policy proposals may lower the incentives to inform, and hence support the persistence of detrimental policies. The discussion of the model and the derivation of these results will be the content of Part II.

[22]Simon (1997) points out that agents' opinions are frequently not derived from experience or learning but by the recommendation of "authorities" like parties are.

Part I

Awareness

Chapter 3

Model

3.1 Introduction

In this part of the thesis we argue that difficulties voters have in recognizing general equilibrium effects can trigger crises when a majoritarian political process determines governmental regulation. But a crisis may help to promote the understanding of general equilibrium effects on the voters' part and this can reverse bad times.

The argument is developed for a two-sector economy in which in the first sector both low- and high-skilled workers are employed. Consider the following democratic process to regulate sector 1: Two political parties propose a minimum wage for low-skilled workers in sector 1, where unemployment is financed by a tax on labor. If workers take all direct and indirect effects into account when voting - called hereinafter General Equilibrium Voting (GEV) - they anticipate that raising low-skilled wages in sector 1 will affect not only labor demand, wages for high skilled workers and prices in sector 1, but also wages in sector 2 and taxes to finance unemployed individuals. The latter general equilibrium effects imply that workers in sector 2 have single-peaked preferences regarding wages for low-skilled workers in sector 1 with market-clearing wages as their most preferred wage. Since high-skilled workers in sector 1 also prefer market-clearing wages over any other wage, a Condorcet winner of the political game exists in each period that is equal to the wage in the unregulated economy as long as the share of low-skilled workers in the first sector is below one-half. As a consequence, there is no unemployment and hence no tax burden. The democratic process implements the free-market solution.

Suppose, however, that when they vote individuals do not take into account general feedback effects in sector 2 connected with the minimum wage proposals in sector 1. We refer to this as Partial Equilibrium Voting (PEV). PEV can be justified by rational ignorance or learning and behavioral approaches related to misconceptions which we discussed in Chapter 2. Voters taking this view, assume that nothing will change in sector 2 , including wages and output in this sector, and also that tax rates will remain constant. If this is the case, workers in sector 2 perceive that - from a certain wage level on - an increase in minimum wages will improve their utility. The following line of reasoning explains this perception:

Aggregate demand for good 2 of the low-skilled workers would increase with a rising minimum wage because unemployed workers would receive compensation. Since the nominal wage of sector 2 workers appears to remain constant under PEV, the same would be true of their real demand for good 2. Accordingly, goods-market clearing in this sector would require a decline in real aggregate demand on the part of the high-skilled workers of sector 1. But a decline in real aggregate demand for good 2 of high-skilled workers would be accompanied by a decline in nominal wages for this group. In a competitive labor market, labor costs per unit of output remain constant (market-clearing). Therefore, a decline in nominal wages would have to be accompanied by a rise in the other components of labor costs. Hence, as the tax rate on labor input is supposed to stay constant under PEV, the relative price of good 1 would have to decrease. With nominal wages constant, this in its turn would increase the real wages of sector 2 workers. Therefore under PEV, their preferred wage is higher than the market-clearing wage.

Together with the low-skilled workers in sector 1, sector 2 workers will vote for an increase in wages, which results in a Condorcet winner higher than market-clearing wages under the PEV view. Furthermore, the economic situation deteriorates over time. After the Condorcet winner is set, a higher equilibrium tax rate is reached. This causes workers in sector 2 to vote for further wage rises since on the basis of the new situation they perceive real wage gains for themselves and no tax rise. As a consequence, the political process will lead to perpetual incremental increases of minimum wages, unemployment and taxes until the economy collapses. One of three situations may occur: First, individuals are not willing to accept high marginal tax rates and react by reducing labor supply or by moving into the shadow economy. Second, the tax burden approaches 100% and employed workers lapse into poverty due to the exploding welfare state. Third, at some time voters may recognize that their PEV view is incorrect and learn GEV.

The general argument of Part I has several possible implications and is related to different strands of the literature.

First, it advances a new argument explaining the production of structural unemployment in democracies in terms of insufficient recognition of general equilibrium effects by voters. It also explains why such events will be reversed by a crisis. Wages that exceed the market-clearing level have been found to be one of the important factors contributing to unemployment, e.g. in France and Germany. We offer a new explanation for this phenomenon and hence our analysis is complementary to the large amount of literature on European unemployment.[1]

Our analysis may also explain why crises in some countries such as Sweden or the Netherlands have triggered a decline in unemployment, which we would interpret as a reversal of detrimental developments due to the emerging wisdom about economic relationships in crises.

Second, our arguments serve to explain why democracies might tend to weaken the capitalist system by increasing amounts of regulations and share of government activity in GDP. The seminal work by Olson (1965, 1982, 1995) has established that in societies that have been stable for some time, firms and workers in many organizations and industries will have been able to organize for collective action. Since societies are not symmetrically organized and as more groups overcome the difficulties of collective action, socially unproductive arrangements occur and welfare decreases. For instance, the secular increase in European unemployment rates can be explained in this way, as the organizational power of insiders increases over time while that of outsiders does not (see Lindbeck and Snower (1988)). Bernholz (1982, 2000) has stressed that the ever-increasing share of government is a consequence of political competition because of the development of interest groups and the presence of rationally uninformed voters. If we interpret PEV as rational ignorance, our arguments suggest that ignorance is sufficient to explain secular increase in tax burdens or unemployment. Moreover, reform projects to reduce market distortions will be implemented if voters recognize the negative effects of regulations in a crisis and switch from PEV to GEV. This is compatible with the arguments advanced by Bernholz (2000).

Moreover, we complement the work of Saint-Paul (2000a). He shows that the redistributive goals motivating labor market institutions in Europe can be achieved at lower cost by using tax and transfer instruments. We argue that insufficient recognition of general equilibrium effects makes a democracy vulnerable to inefficient regulation.

Our analysis may also shed some light on the rise and fall of market distortions. We hope it also provides a useful framework for other regulatory issues, such as protectionism or competition policy. Furthermore, it is complementary to examinations on

[1]Surveys and detailed accounts of labor market factors as root causes of the unemployment problem in Europe can be found in Blanchard and Katz (1997), Blanchard and Summers (1986), Burda and Wyplosz (1994), Layard, Nickell, and Jackman (1991), Snower (1993), Bean (1994), Krugman (1994), Franz (1995) , Minford (1995), OECD (1995), Paque (1995), Alogoskoufis, Bean, Bertola, Cohen, Dolado, and Saint-Paul (1996), Saint-Paul (1996a, 1996c, 1999), Giersch (1996), Gersbach and Sheldon (1996), Lindbeck (1996), Oswald (1996), Siebert (1997), Nickell (1997).

how the awareness of general equilibrium effects affects wage negotiations by unions and employer associations. Gersbach and Schniewind (2001) have established a non-monotonic relationship between the degree of recognition of general equilibrium effects and unemployment. Here we examine how awareness of specific general equilibrium effects impacts on democratic processes.

Part I is organized as follows. In Section 3.2 we set up the model and derive the market equilibrium of the economy, which coincides with the perceived GEV equilibrium. The dynamics of the political process are described in Section 3.3. We specify what GEV and PEV exactly mean in terms of equations constituting the perceived equilibria. This also leads us to the perceived PEV equilibrium. In Chapter 4, the utility functions depending on the minimum wage of the low-skilled workers are derived for each view and for each group of workers. This results in the different political equilibria, i.e. the chosen minimum wages in each time period and in the long-run. We compare the results from GEV with PEV and discuss how the political and economic system reacts to the emerging crisis under PEV. We interpret the results economically by describing the economic reasoning process of voters under each view. The complete analysis is repeated in Chapter 5 for a slight variation in voters' view compared to PEV. We call the additionally discussed standpoint of voters PEV1. In Chapter 6 we shed some light on the robustness of our results, make an overall comparison for the different possible views, and conclude.

3.2 The Basic Economic Model

In this section, we introduce the model of the economy on which we base our examination of the voting processes on minimum wages. There are two sectors respectively producing good 1 and good 2. The only input into production is labor.[2] The production functions are given by:

$$q_1 = L_{1l}^{\beta} L_{1h}^{(1-\beta)} \tag{3.1}$$

with $\beta < 1$ and

$$q_2 = L_2 \tag{3.2}$$

Subscripts 1 and 2 denote the first and second sector, respectively. h stands for the

[2] In the long-run, there is no loss of generality associated with neglecting capital, provided that capacity constraints are not binding and the long-run capital stock is determined by equating the marginal product of capital with the real-world interest.

high-skilled workers of sector 1, l for the low-skilled. In sector 2 we only have one skill level for the whole work-force.

We assume perfectly competitive good markets and immobility of workers across industries and skill levels. Labor supply is assumed to be inelastic and is given by $\overline{L}_{1l}$ for the low-skilled labor market in sector 1, by $\overline{L}_{1h}$ for the high-skilled labor market in sector 1, and by $\overline{L}_2$ in sector 2. Firm owners are the high-skilled workers of sector 1 and the workers of sector 2. Each of them receives an equal share of the sum $\pi_1 + \pi_2$ of all the profits earned in both sectors.[3]

Furthermore, we assume that all types of workers have the same symmetric Cobb-Douglas utility function:[4]

$$u = c_1^{\frac{1}{2}} c_2^{\frac{1}{2}} \tag{3.3}$$

where c_1 and c_2 denote the consumption levels of good 1 and good 2.

In the political process involving all workers as voters, the minimum nominal wage w_{1l} for the low-skilled workers of sector 1 is set. In order that nominal wages have real effects, we need a further price rigidity and we assume that the price in sector 2 is constant.[5]

Thus, we can normalize p_2 to one:

$$p_2 = 1 \tag{3.4}$$

The appropriate consumer price index is:

$$p = p_1^{\frac{1}{2}} p_2^{\frac{1}{2}} = p_1^{\frac{1}{2}} \tag{3.5}$$

This price index guarantees that changes in prices do not affect household utility as long as real income remains constant.

Since p_2 is fixed, the real wage can exceed the market-clearing wage for the low-skilled workers.[6] As a result, unemployment can occur in this market. We assume that workers who have lost their jobs receive an exogenously given fraction $s \in (0, 1]$ of the

[3]The assumed production technologies imply constant returns to scale. Therefore we have zero profits as long as firms can satisfy their optimal labor demand.

[4]The symmetry assumption is made solely for ease of presentation. However, the assumption of constant and equal elasticities of substitution across all individuals is essential.

[5]Alternatively, we could assume that real minimum wages are set directly in the political sphere.

[6]Since $p_2 = 1$, w_{1l} is the price of low-skilled labor in terms of good 2.

minimum wage as unemployment benefits. In order to finance the benefits, labor is taxed by a fraction τ of the nominal wages they pay, i.e., τ is a payroll tax.

Finally, we assume that each of the three types of workers is a fraction of the population smaller than fifty percent:

$$\frac{\overline{L}_f}{\overline{L}_{1l} + \overline{L}_{1h} + \overline{L}_2} < \frac{1}{2} \tag{3.6}$$

where $f = 1l, 1h, 2$.

First Order Conditions for the Market Equilibrium In the first step we derive demand and supply for goods and labor. By utility maximization for an individual worker we receive the following demand equations for consumption:

$$c_1^f = \frac{1}{2}\frac{b_f}{p_1} \tag{3.7}$$

$$c_2^f = \frac{1}{2}b_f \tag{3.8}$$

where $f = 1l, 1h, 2$ refers to the employed workers and $f = un$ refers to the unemployed. The budgets b_f are $w_f + \frac{\pi_1+\pi_2}{\overline{L}_{1h}+\overline{L}_2}$ for $f = 1h, 2$. For the employed low-skilled b_{1l} equals w_{1l} and for $f = un$ we have:

$$b_{un} = sw_{1l} \tag{3.9}$$

Profits of firms are sales minus costs and thus given as:

$$\pi_1 = p_1 q_1 - w_{1l}(1+\tau)L_{1l} - w_{1h}(1+\tau)L_{1h} \tag{3.10}$$

$$\pi_2 = q_2 - w_2(1+\tau)L_2 \tag{3.11}$$

Firms are price-takers in both sectors. We obtain the first-order conditions for profit maximization in sector 1 and 2 as:

$$w_{1l}(1+\tau) = p_1\beta\Big(\frac{L_{1h}}{L_{1l}}\Big)^{(1-\beta)} \tag{3.12}$$

$$w_{1h}(1+\tau) = p_1(1-\beta)\Big(\frac{L_{1l}}{L_{1h}}\Big)^{\beta} \tag{3.13}$$

$$w_2(1+\tau) = 1 \tag{3.14}$$

Labor demand in sector 2 is perfectly elastic as long as gross wages do not exceed the value of 1. [7]

Both unregulated labor markets clear:

$$L_{1h} = \overline{L}_{1h} \tag{3.15}$$

$$L_2 = \overline{L}_2 \tag{3.16}$$

The governmental budget constraint is given by:

$$(w_{1l}L_{1l} + w_{1h}L_{1h} + w_2 L_2)\tau = \Delta b_{un} \tag{3.17}$$

where Δ denotes the unemployed work-force:

$$\Delta = \overline{L}_{1l} - L_{1l} \tag{3.18}$$

Using realized budgets we can apply Walras' law to the goods markets.[8] Therefore it suffices to clear one of the two goods markets:

$$L_{1l}c_2^{1l} + L_{1h}c_2^{1h} + L_2 c_2^2 + \Delta c_2^{un} = q_2 \tag{3.19}$$

The Market Equilibrium We obtain a system of eight equations for the eight variables $\tau, w_{1h}, w_2, p_1, L_{1l}, L_{1h}, L_2, \Delta$. The system consists of the equations for labor demand ((3.12),(3.13), (3.14)), the governmental budget constraint ((3.17),(3.18)), and the market-clearing conditions ((3.15),(3.16),(3.19)). Solving the system yields the following equilibrium solution $E(w_{1l})$:

[7] If gross wages do not exceed 1, profits are non-negative and independent of the employed labor force. If gross wages are higher than 1, profits are negative and the firm closes down.

[8] As workers adjust their demand for goods to their actual realized budgets, goods markets clear in spite of unemployment in one labor market.

$$\tau(w_{1l}) = \frac{s(\beta\overline{L}_2 - w_{1l}\overline{L}_{1l})}{sw_{1l}\overline{L}_{1l} - 2\overline{L}_2} \quad (3.20)$$

$$w_{1h}(w_{1l}) = \Big(\frac{1-\beta}{1+\tau}\Big)\frac{\overline{L}_2}{\overline{L}_{1h}} \quad (3.21)$$

$$w_2(w_{1l}) = \frac{1}{1+\tau} \quad (3.22)$$

$$p_1(w_{1l}) = \Big(\frac{\overline{L}_2}{\overline{L}_{1h}}\Big)^{1-\beta}\Big(\frac{w_{1l}(1+\tau)}{\beta}\Big)^{\beta} \quad (3.23)$$

$$L_{1l}(w_{1l}) = \beta\overline{L}_2\frac{1}{w_{1l}(1+\tau)} \quad (3.24)$$

$$L_{1h}(w_{1l}) = \overline{L}_{1h} \quad (3.25)$$

$$L_2(w_{1l}) = \overline{L}_2 \quad (3.26)$$

$$\Delta(w_{1l}) = \overline{L}_{1l} - \beta\overline{L}_2\frac{1}{w_{1l}(1+\tau)} \quad (3.27)$$

Note that τ strictly increases in w_{1l}.[9] In the absence of regulation, the low-skilled labor market in sector 1 also clears. Then we have $L_{1l} = \overline{L}_{1l}$ with $\tau = 0$ and from equation (3.24) we determine the lowest possible minimum wage as:

$$w_{1l}^{min} = \beta\frac{\overline{L}_2}{\overline{L}_{1l}} \quad (3.28)$$

For the maximum value of w_{1l} we have:

$$w_{1l}^{max} = \frac{2\overline{L}_2}{s\overline{L}_{1l}} \quad (3.29)$$

For $w_{1l} > w_{1l}^{max}$ we can verify that w_{1h}, w_2 and L_{1l} become negative and that p_1 becomes complex. Therefore they represent infeasible values. Furthermore, if w_{1l} is smaller than w_{1l}^{max} and $w_{1l} \to w_{1l}^{max}$, we obtain $\tau \to \infty$.

3.3 The Political Process

3.3.1 Views

In this section, we will present the political process and the two alternative views voters can obey. We call these views GEV and PEV. In each voting period and based on their view, voters calculate their utility levels depending on the minimum wage

[9] The first derivative of τ with respect to w_{1l} is $\frac{s\overline{L}_{1l}\overline{L}_2(2-s\beta)}{(sw_{1l}\overline{L}_{1l}-2\overline{L}_2)^2} > 0$.

$w_{1l,t}$. In their short-run voting decision, i.e., in their voting decision in the particular voting period t, they consider the level of $w_{1l,t}$ which maximizes their utility:

$$\underset{w_{1l,t}}{\operatorname{argmax}}\, u(\tilde{E}_t^v(w_{1l,t}))$$

where $\tilde{E}_t^v$ denotes the perceived short-run market equilibrium connected with a particular view, i.e., $v = \text{GEV}$ or $v = \text{PEV}$. As discussed later on in Section 3.3.2 "Dynamics and Crisis", the political process generates the Median-voter's ideal wage as short-run political equilibrium $\hat{w}_{1l,t}$. If this equilibrium minimum wage is implemented the economy reaches the market equilibrium $E(\hat{w}_{1l,t})$. In the following, we wish to discuss the short-run equilibria under the two different views in detail.

3.3.1.1 Perceived Short-Run Political Equilibria under General Equilibrium Voting (GEV)

Under General Equilibrium Voting (GEV), voters consider all general equilibrium effects represented by equations (3.12)-(3.19). Therefore they correctly anticipate the market equilibrium $E(w_{1l,t})$. We denote the Median-voter's ideal wage under GEV by $\hat{w}_{1l,t}^{GEV}$ and the actually achieved equilibrium under GEV by $E_t^{GEV} = E_t(\hat{w}_{1l,t}^{GEV})$. As the voters' perceived equilibrium $\tilde{E}_t^{GEV}$ equals the equilibrium E_t^{GEV} actually achieved, the optimal wage before voting is still optimal after the new equilibrium has been achieved and voters have no reason to change their ideal wages after casting their votes the first time. Thus, under GEV, we have $\hat{w}_{1l,t}^{GEV} = ... = \hat{w}_{1l,1}^{GEV} = \hat{w}_{1l,0}^{GEV}$ as short-run political equilibria as well as $E_t^{GEV} = ... = E_1^{GEV} = E_0^{GEV}$ as short-run market equilibria.

3.3.1.2 Perceived Short-Run Political Equilibria under Partial Equilibrium Voting (PEV)

Under Partial Equilibrium Voting (PEV), not all effects are taken into account by voters. We assume that voters only consider changes in the regulated sector. They proceed on the assumption that the variables in sector 2 and the tax rate τ do not change, i.e. w_2, L_2 and τ are assumed to stay constant. Therefore under PEV voters anticipate that changing wages in sector 1 will affect prices and output in this sector, while they do not take into account general equilibrium repercussions from the economy on tax rate adjustments by the government. Thus, PEV represents the plausible assumption that agents (can) only consider direct effects of regulatory changes when they cast their votes.

There are various lines of justification to consider voting in the sense of partial equilibrium voting (see also Chapter 2).

First, the literature on what voters know and do not know (e.g. Lupia and McCubbins (1998)) suggests that individuals often use a simplified framework to cast their votes. Moreover, the lack of incentives of voters to search for more information and the resulting rational ignorance has been a dominant theme in public choice (e.g. Mueller (1995), Bernholz and Breyer (1994), Gersbach (1995)).

Second, the literature on learning summarized in Evans and Honkapohja (2001), Fudenberg and Levine (1998), and Sargent (1993) and the broad theme of behavioral economics have identified a variety of reasons why agents may deviate from rational expectations. For instance, voters assuming that higher wages in sector 1 does not affect sector 2 might be interpreted as an overconfidence bias or as a misconception in the sense of Mullainathan and Thaler (2000) or Romer (2003).

Third, the assumption that voters do not take into account the actual effects has broad parallels that go back at least to Negishi's subjective demand approach where firms in oligopolies have subjective demands at the anticipation stage from which they derive their reaction functions (Negishi (1961), Ginsburgh and Keyzer (1997)). In our examination all agents are price takers and therefore have standard Cobb-Douglas demand functions but may have subjective forecasts about general equilibrium effects when they vote.

Formally, in period t under PEV voters apply equations (3.12), (3.13), (3.15) and (3.18) which directly describe the behavior of agents in sector 1:

$$\begin{aligned} w_{1l,t}(1+\tau_t) &= p_{1,t}\beta\Big(\frac{L_{1h,t}}{L_{1l,t}}\Big)^{(1-\beta)} \\ w_{1h,t}(1+\tau_t) &= p_{1,t}(1-\beta)\Big(\frac{L_{1l,t}}{L_{1h,t}}\Big)^{\beta} \\ L_{1h,t} &= \overline{L}_{1h} \\ \Delta_t &= \overline{L}_{1l} - L_{1l,t} \end{aligned}$$

From the voters' point of view sector 2 is not affected at all. Therefore, they assume clearance of the market for good 2 (3.19):

$$L_{1l,t}c_{2,t}^{1l} + L_{1h,t}c_{2,t}^{1h} + L_{2,t}c_{2,t}^{2} + \Delta_t c_{2,t}^{un} = q_{2,t}$$

Voters base their considerations in period t on the realization of some variables in $t-1$ that are presumed to stay constant. We use $\hat{w}_{1l,t}^{PEV}$ to denote the Condorcet winner under PEV in period t, which now depends on E_{t-1}, i.e. $\hat{w}_{1l,t}^{PEV}(E_{t-1}^{PEV})$, where E_{t-1}^{PEV} is the equilibrium realized under PEV in period $t-1$. Since voters only partially anticipate the resulting equilibrium under PEV, we use $\tilde{E}_t^{PEV}(w_{1l,t})$ to denote the equilibrium perceived by voters when they determine $\hat{w}_{1l,t}^{PEV}$. To derive $\tilde{E}_t^{PEV}(w_{1l,t})$ we solve the system of 5 equations ((3.12),(3.13),(3.15),(3.18),(3.19)) for the perceived equilibrium values denoted by $\tilde{w}_{1h,t}, \tilde{p}_{1,t}, \tilde{L}_{1l,t}, \tilde{L}_{1h,t}$ and $\tilde{\Delta}_t$:

$$\tilde{\tau}_t^{PEV}(w_{1l,t}) = \tau_{t-1}^{PEV} \tag{3.30}$$

$$\tilde{w}_{1h,t}^{PEV}(w_{1l,t}) = (1-\beta)\frac{\epsilon_t(w_{1l,t})}{\overline{L}_{1h}} \tag{3.31}$$

$$\tilde{w}_{2,t}^{PEV}(w_{1l,t}) = \frac{1}{1+\tau_{t-1}^{PEV}} \tag{3.32}$$

$$\tilde{p}_{1,t}^{PEV}(w_{1l,t}) = (1+\tau_{t-1}^{PEV})\Big(\frac{\epsilon_t(w_{1l,t})}{\overline{L}_{1h}}\Big)^{1-\beta}\Big(\frac{w_{1l,t}}{\beta}\Big)^{\beta} \tag{3.33}$$

$$\tilde{L}_{1l,t}^{PEV}(w_{1l,t}) = \beta\frac{\epsilon_t(w_{1l,t})}{w_{1l,t}} \tag{3.34}$$

$$\tilde{L}_{1h,t}^{PEV}(w_{1l,t}) = \overline{L}_{1h} \tag{3.35}$$

$$\tilde{L}_{2,t}^{PEV}(w_{1l,t}) = \overline{L}_{2} \tag{3.36}$$

$$\tilde{\Delta}_t^{PEV}(w_{1l,t}) = \overline{L}_{1l} - \beta\frac{\epsilon_t(w_{1l,t})}{w_{1l,t}} \tag{3.37}$$

where

$$\epsilon_t(w_{1l,t}) = \frac{\overline{L}_2 + \tau_{t-1}^{PEV} w_{2,t-1}^{PEV}\overline{L}_2 - s w_{1l,t}\overline{L}_{1l}}{1-s\beta} \tag{3.38}$$

and τ_{t-1}^{PEV} and $w_{2,t-1}^{PEV}$ are the actual realized values of τ and w_2 under PEV in period $t-1$.

Note that $\epsilon_t(w_{1l,t})$ strictly decreases in $w_{1l,t}$ and that for the solution to be meaningful $\epsilon_t(w_{1l,t})$ has to be non-negative. Therefore, under PEV the perceived maximum wage for the low-skilled of sector 1 is:

$$\tilde{w}_{1l,t}^{PEV,max} = \frac{\overline{L}_2 + \tau_{t-1}^{PEV} w_{2,t-1}^{PEV}\overline{L}_2}{s\overline{L}_{1l}} \tag{3.39}$$

If $w_{1l,t} = \tilde{w}_{1l,t}^{PEV,max}$, then voters perceive that all low-skilled workers of sector 1 are unemployed and thus, output in this sector is zero.

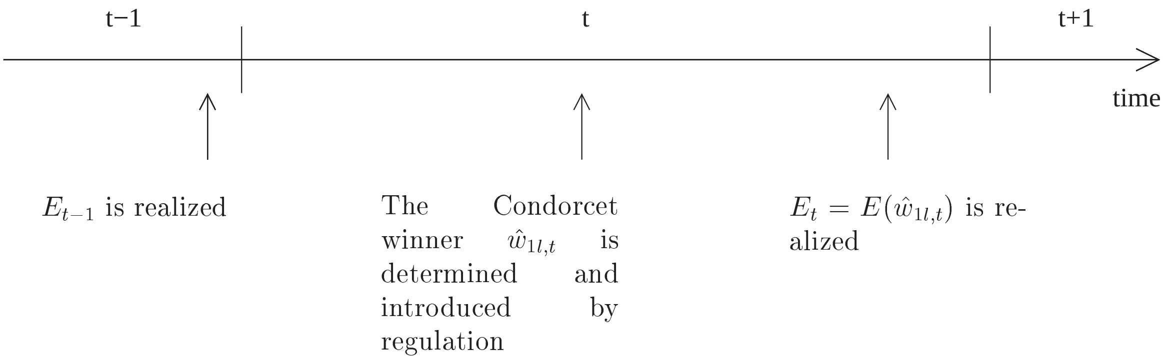
As can be seen from equations (3.30) to (3.38) the perceived equilibrium $\tilde{E}_t^{PEV}(w_{1l,t})$ in period t depends on the actually realized tax rate τ_{t-1}^{PEV} of the previous period. Consequently, the optimal minimum wage each voter group prefers to be implemented depends on the political equilibrium $\hat{w}_{1l,t-1}^{PEV}$ of the previous period. Therefore, we can write for the short-run political equilibrium $\hat{w}_{1l,t}^{PEV}$ of period t:

$$\hat{w}_{1l,t}^{PEV} = \hat{w}_{1l,t}^{PEV}(E_{t-1}(\hat{w}_{1l,t-1}^{PEV}))$$

where E_{t-1} denotes the actually realized equilibrium solution in period $t-1$.

3.3.2 Dynamics and Crisis

Figure 3.1: The political and economic process



In this section we introduce the political process in detail. For that purpose we develop a dynamic framework. There is an infinite number of time periods, indexed by $t = 0, 1, ...$. In each period the static economy from the last section is at work and we use $E(w_{1l,t})$ or E_t to denote the equilibrium realized in period t after $w_{1l,t}$ has been determined. Within this framework the political process unfolds as follows: In each period each agent acts as a voter. Voters determine the minimum wage $w_{1l,t}$ through majority rule. Although we work directly with the Condorcet winner[10], we have the standard model of two-party competition in mind which generates the Median-voter result.[11] In every period, the preferred wage by the Median-voter, denoted by $\hat{w}_{1l,t}$ is introduced in the economy. We use $\hat{w}_{1l,t}$ to refer to the short-run political equilibrium. Since we have three different types of workers, we will in general also have three different ideal wage levels. The political and economic process is summarized in Figure 3.1.

The long-run behavior of the equilibrium can exhibit two patterns. First, at some point in time a wage $\hat{w}_{1l,t}$ is determined in the political sphere such that $\hat{w}_{1l,t} > w_{1l}^{max}$, variables are not longer economically feasible, and the economy collapses. This means that output in sector 1 is zero and the tax rate infinitely large. This is bound to lead

[10]This is the minimum wage that defeats all other values of $w_{1l,t}$ in pairwise majority voting

[11]As we will see in the next section, the Median-voter corresponds to the Condorcet winner despite the fact that not all preferences are single-peaked.

to a political crisis where voters as consumers and tax payers are no longer willing to accept the economic situation. Therefore they may wish to return to former values of the minimum wage or they may recognize that their view has been misleading so far (see Section 4.4).

Second, no economic collapse occurs, i.e., $\hat{w}_{1l,t} \leq w_{1l}^{max}$ in all periods. If $\lim_{t\to\infty} \hat{w}_{1l,t}$ and $\lim_{t\to\infty} E(\hat{w}_{1l,t})$ exist, we denote them by $\hat{w}_{1l}^*$ and E^* respectively and use $\hat{w}_{1l}^*$ to refer to the long-run political equilibrium of the process.[12]

On its path, the political process may generate a crisis or a reversal. The concept of a crisis can be defined by three cases:

In the first scenario, the sequence of $\hat{w}_{1l,t}$ converges to or reaches w_{1l}^{max}. Then, τ becomes infinitely large and we observe a political and economic crisis. This is because the real wages of the high-skilled of sector 1 and the workers of sector 2 are zero, as is output in sector 1. Furthermore, all low-skilled workers have lost their jobs. We call this a crisis with unlimited tax tolerance (CUTT), because voters then accept any tax rate imposed by the government.

In the second scenario, the latter is not the case and a crisis with limited tax tolerance (CLTT) occurs. In period T, the equilibrium tax rate exceeds a value $\tau_{max} < \infty$ that tax payers would accept.[13] We assume that if $\tau > \tau_{max}$ tax payers will either reduce labor supply or try to avoid taxes by moving into the shadow economy. Strictly speaking, to rationalize the reduction of labor supply one has to assume that workers receive utility from consuming leisure time. Then, our simplified assumption is that the elasticity of labor supply is small for $\tau \leq \tau_{max}$ and larger for $\tau > \tau_{max}$. As a consequence, the state's budget constraint cannot be satisfied with a tax rate exceeding τ_{max} and a crisis emerges even before the equilibrium tax rate τ approaches infinity. While we do not explicitly model the reaction of individuals where $\tau > \tau_{max}$, it is obvious that the budget constraints will be violated if the amount of taxable labor income declines sufficiently.

Third, it could happen that voters, after experiencing a discrepancy between expected and realized utility levels for a certain time, recognize that the PEV view is incorrect and switch to GEV. Since that third scenario is qualitatively similar to the second scenario, we shall focus on the first two cases.

We summarize our concept of a crisis in the following definition.

[12] If $\hat{w}_{1l}^*$ is reached in finite time, the wages and the equilibrium of the economy remain constant thereafter.

[13] For example, if $\tau > 1$ more than fifty percent of the gross wage would be taxed as described in equation (3.22).

Definition 1 (Crisis with Limited and Unlimited Tax Tolerance)
Suppose the sequence of short-run political equilibria $\hat{w}_{1l,t}$ *converges to a long-run equilibrium* $\hat{w}^*_{1l}$. *Suppose further that all short-run equilibria are economically feasible, i.e.,* $\hat{w}_{1l,t} \leq w^{max}_{1l}$, *where* w^{max}_{1l} *denotes the maximal feasible wage level. Beyond this maximum wage level the economy collapses with output zero in sector 1. We distinguish two cases:*

- **Crisis with limited tax tolerance (CLTT):** *In some period* T *the short-run political equilibrium in this period exceeds a level* $\tau_{max} < \infty$. *Tax payers are not willing to accept a tax rate higher than* τ_{max}. *Workers as tax payers will reduce labor supply or move into the shadow economy. The state's budget constraint cannot be satisfied any longer.*
- **Crisis with unlimited tax tolerance (CUTT):** *The sequence* $\hat{w}_{1l,t}$ *of short-run political equilibria converges to* w^{max}_{1l}. *Voters accept any tax rate imposed by the government. The crisis realized in the long-run equilibrium* w^{max}_{1l} *is characterized by the fact that all low-skilled workers in sector 1 have lost their jobs, and therefore output is zero in sector 1.*

Chapter 4

Long-Run Political Equilibria

On the basis of our conceptual framework we can now derive the political equilibria under GEV and PEV. For this, we need to identify the utility functions of voter groups, their optimal minimum wages and the Condorcet winners.

4.1 Long-Run Political Equilibria under General Equilibrium Voting (GEV)

Using a positive monotone transformation $U = 2\ln u$ of utility function u (see equation (3.3)), we obtain for the workers of sector 2 in period t:[1]

$$\tilde{U}_{2,t}^{GEV} = \ln\Big(\frac{1}{2}\frac{\tilde{w}_{2,t}^{GEV}}{\tilde{p}_{1,t}^{GEV}}\Big) + \ln\Big(\frac{1}{2}\tilde{w}_{2,t}^{GEV}\Big) \tag{4.1}$$

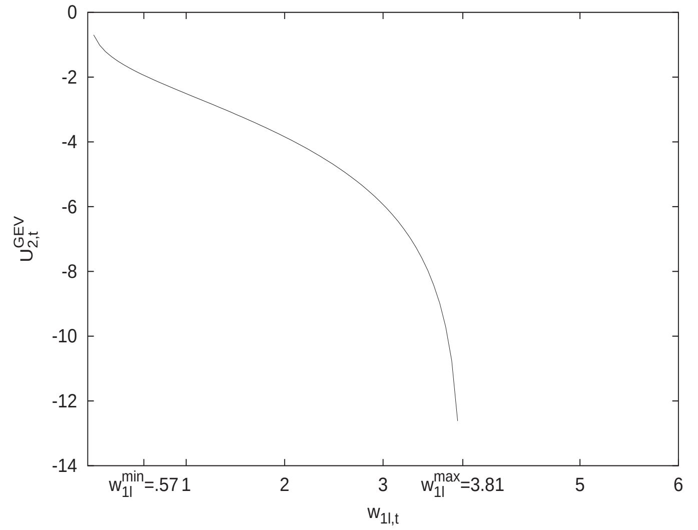
Given $\tilde{E}_t^{GEV} = E_t^{GEV} = E_t$, the perceived variables equal the actual realized variables and therefore, *from now on, we dispense with the tilde for variables under GEV.*

Using equations (3.22) and (3.23) and the fact that τ_t^{GEV} strictly increases in $w_{1l,t}$ we find that $w_{2,t}^{GEV}$ strictly decreases and $p_{1,t}^{GEV}$ strictly increases in $w_{1l,t} \in (0, w_{1l}^{max})$. Thus $U_{2,t}^{GEV}$ strictly decreases in $w_{1l,t} \in (0, w_{1l}^{max})$ and voters of sector 2 will prefer the lowest possible wage w_{1l}^{min} for the low- skilled of sector 1.

To illustrate this fact, we plot the utility functions of workers of sector 2 with the following parameter values for the economy: $s = 0.75, \beta = 0.4, \overline{L}_{1l} = 70,000, \overline{L}_{1h} = 50,000$ and $\overline{L}_2 = 100,000$. For these values we obtain $w_{1l}^{min} = 0.57$ and $w_{1l}^{max} = 3.81$. Furthermore, unless otherwise indicated, we use these values for the illustrations of all other functions in Part I.

[1] Since production technologies exhibit constant returns to scale profits are zero and workers' budgets only consist of wages.

Figure 4.1: $U_{2,t}^{GEV}$ with $s = 0.75$ and $\beta = 0.4$



For the high-skilled of sector 1 we obtain:

$$U_{1h,t}^{GEV} = \ln\left(\frac{1}{2}\frac{w_{1h,t}^{GEV}}{p_{1,t}^{GEV}}\right) + \ln\left(\frac{1}{2}w_{1h,t}^{GEV}\right) \tag{4.2}$$

Because of equations (3.21) and (3.23) and the fact that τ_t^{GEV} strictly increases in $w_{1l,t}$, $w_{1h,t}^{GEV}$ strictly decreases and $p_{1,t}^{GEV}$ strictly increases in $w_{1l,t} \in (0, w_{1l}^{max})$. Thus $U_{1h,t}^{GEV}$ strictly decreases in $w_{1l,t} \in (0, w_{1l}^{max})$ and the high-skilled workers of sector 1 will also prefer w_{1l}^{min}.

We can summarize our observations in the following lemma:

Lemma 1
$U_{2,t}^{GEV}(w_{1l,t})$ and $U_{1h,t}^{GEV}(w_{1l,t})$ have the following properties in $w_{1l,t} \in (0, w_{1l}^{max})$:

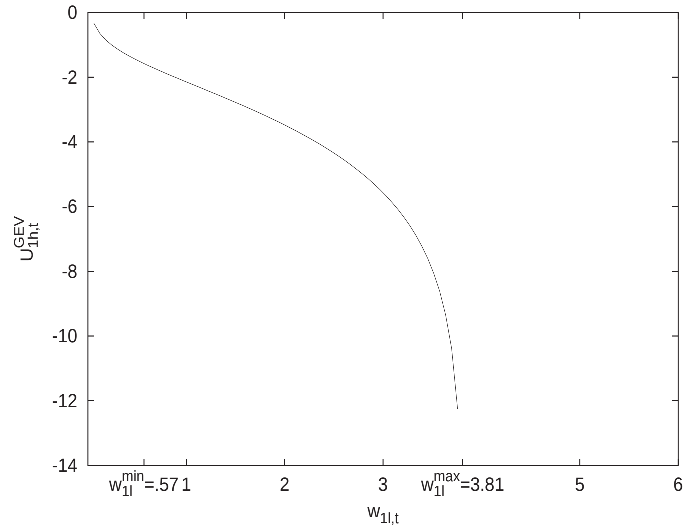
(i) $U_{2,t}^{GEV}(w_{1l,t})$ and $U_{1h,t}^{GEV}(w_{1l,t})$ strictly decrease in $w_{1l,t}$.

(ii) The workers of sector 2 and the high-skilled workers of sector 1 maximize their utilities $U_{2,t}^{GEV}(w_{1l,t})$ and $U_{1h,t}^{GEV}(w_{1l,t})$ if they choose the lowest possible wage w_{1l}^{min}.

As two groups of workers always have a single majority of voters, the short-run political equilibrium under GEV in each period is given by:

$$\hat{w}_{1l,t}^{GEV} = w_{1l}^{min} = \beta\frac{\overline{L}_2}{\overline{L}_{1l}} \tag{4.3}$$

Figure 4.2: $U^{GEV}_{1h,t}$ under GEV with $s = 0.75$ and $\beta = 0.4$



Furthermore, at w_{1l}^{min} all values are economically feasible and $\tau = 0$. Thus, we can conclude:

Proposition 1 (The Long-Run Political Equilibrium under GEV)
Under GEV, neither CLTT nor CUTT occurs and the long-run political equilibrium of the voting process equals the short-run equilibria in each period. It is given by:

$$\hat{w}_{1l}^{GEV*} = \hat{w}_{1l,t}^{GEV} = \beta \frac{\overline{L}_2}{\overline{L}_{1l}}$$

There is no unemployment and the equilibrium is equal to the unregulated economy.

For completeness we also analyze the utility of the low-skilled workers in sector 1. They have a von Neumann-Morgenstern expected utility function:

$$U_{1l,t}^{GEV} = \frac{L_{1l,t}^{GEV}}{\overline{L}_{1l}} \Big\{ \ln\Big(\frac{1}{2}\frac{w_{1l,t}}{p_{1,t}^{GEV}}\Big) + \ln\Big(\frac{1}{2}w_{1l,t}\Big)\Big\} + \frac{\Delta_t^{GEV}}{\overline{L}_{1l}} \Big\{ \ln\Big(\frac{1}{2}s\frac{w_{1l,t}}{p_{1,t}^{GEV}}\Big) + \ln\Big(\frac{1}{2}sw_{1l,t}\Big)\Big\}$$

This can be simplified to:

$$U_{1l,t}^{GEV} = -2\frac{L_{1l,t}^{GEV}}{\overline{L}_{1l}} \ln(s) + 2\ln(w_{1l,t}) - \ln(p_{1,t}^{GEV}) + 2\ln(s) - 2\ln(2) \qquad (4.4)$$

Lemma 2
$U_{1l,t}^{GEV}(w_{1l,t})$ has the following properties in $w_{1l,t} \in (0, w_{1l}^{max})$:

(i) $\lim_{w_{1l,t}\to 0} U_{1l,t}^{GEV} = \infty$ *and* $\lim_{w_{1l,t}\to w_{1l}^{max}} U_{1l,t}^{GEV} = -\infty$.

(ii) Depending on s and β, the optimal wage for the low-skilled workers of sector 1 can exceed w_{1l}^{min}.

The proof of (i) can be found in the appendix. To illustrate (ii) we can make the following considerations and computations:

For $\partial U_{1l,t}^{GEV}/\partial w_{1l,t} = 0$ we obtain a polynomial of degree two in $w_{1l,t}$. Consequently, for $w_{1l,t} \in (0, w_{1l}^{max})$ there can be two or less values of $w_{1l,t}$ satisfying the necessary conditions for optimal points. They depend on the parameters s, β, $\overline{L}_{1l}$, and $\overline{L}_2$. [2] Considering the course of $U_{1l,t}^{GEV}$, which is a continuous and differentiable function for $w_{1l,t} \in (0, w_{1l}^{max})$, we can draw further conclusions: If there are two values satisfying the necessary and sufficient conditions for local optima, the smaller must be a local minimizer and the larger a local maximizer. In this case, if w_{1l}^{min} is larger than the local minimizer and smaller than the maximizer, the low-skilled workers of sector 1 will prefer a minimum wage that exceeds w_{1l}^{min}. If w_{1l}^{min} is smaller than both optimal points, it is possible that w_{1l}^{min} will be the best choice. At all events, if w_{1l}^{min} exceeds the local maximizer it is automatically the best choice. In all other conceivable cases $U_{1l,t}^{GEV}$ must depend negatively on $w_{1l,t}$ for $w_{1l,t} \in (0, w_{1l}^{max})$ [3] and the low- skilled choose w_{1l}^{min}.[4] Figure 4.3, p. 42, shows $U_{1l,t}^{GEV}$ for the parameter values given above with an optimal wage exceeding w_{1l}^{min}.

4.2 Long-Run Political Equilibria under Partial Equilibrium Voting (PEV)

In the following, we derive the technical results under PEV. In Section 4.5 we provide intuitive explanations of the results.

Before we look at the utility functions themselves, it is useful to analyze $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$ in its meaningful range, i.e. for $w_{1l,t} \in [0, \tilde{w}_{1l,t}^{PEV,max}]$:

$$\tilde{p}_{1,t}^{PEV} = (1 + \tau_{t-1}^{PEV})\Big(\frac{\epsilon_t(w_{1l,t})}{\overline{L}_{1h}}\Big)^{1-\beta}\Big(\frac{w_{1l,t}}{\beta}\Big)^{\beta}$$

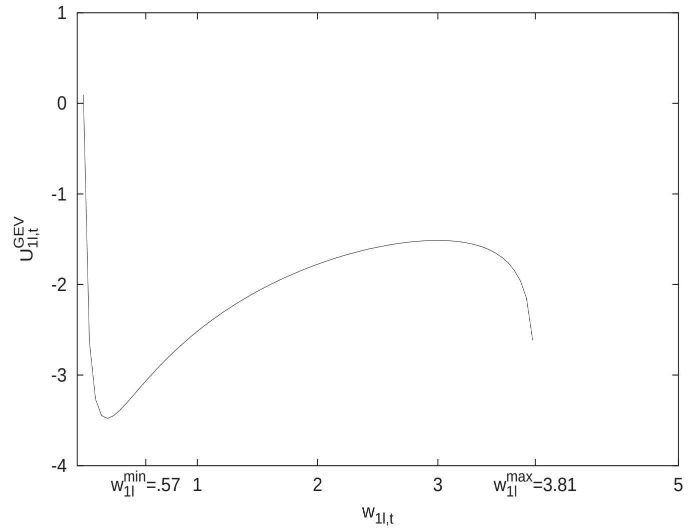
The first derivative of $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$ with respect to $w_{1l,t}$ is:

[2] We used the software package MAPLE to solve $\partial U_{1l,t}^{GEV}/\partial w_{1l,t} = 0$ for $w_{1l,t}$. Whether the critical points are larger or smaller than w_{1l}^{min} depends solely on s and β.

[3] There are values of $w_{1l,t} \in (0, w_{1l}^{max})$ which are critical points but neither of them is a local minimizer or a local maximizer.

[4] Unfortunately, it is not possible to analyze $U_{1l,t}^{GEV}$ analytically.

Figure 4.3: $U_{1l,t}^{GEV}$ with $s = 0.75$ and $\beta = 0.4$



$$\frac{\partial \tilde{p}_{1,t}^{PEV}}{\partial w_{1l,t}} = \tilde{p}_{1,t}^{PEV}\Big((1-\beta)\frac{-s\overline{L}_{1l}}{\overline{L}_2 + \tau_{t-1}^{PEV} w_{2,t-1}^{PEV}\overline{L}_2 - s w_{1l,t}\overline{L}_{1l}} + \frac{\beta}{w_{1l,t}}\Big) \tag{4.5}$$

and for $w_{1l,t} \in [0, \tilde{w}_{1l,t}^{PEV,max}]$ we find one value of $w_{1l,t}$ that satisfies $\partial \tilde{p}_{1,t}^{PEV}/\partial w_{1l,t} = 0$ as expressed in the next lemma.

Lemma 3
There exists a unique value $\tilde{w}_{1l,t}^{p_1}$ that maximizes $\tilde{p}_{1,t}^{PEV}$ for $w_{1l,t} \in [0, \tilde{w}_{1l,t}^{PEV,max}]$:

$$\tilde{w}_{1l,t}^{p_1} = \beta \tilde{w}_{1l,t}^{PEV,max} = \beta\frac{\overline{L}_2 + \tau_{t-1}^{PEV} w_{2,t-1}^{PEV}\overline{L}_2}{s\overline{L}_{1l}} \tag{4.6}$$

The proof of Lemma 3 can be found in the appendix.

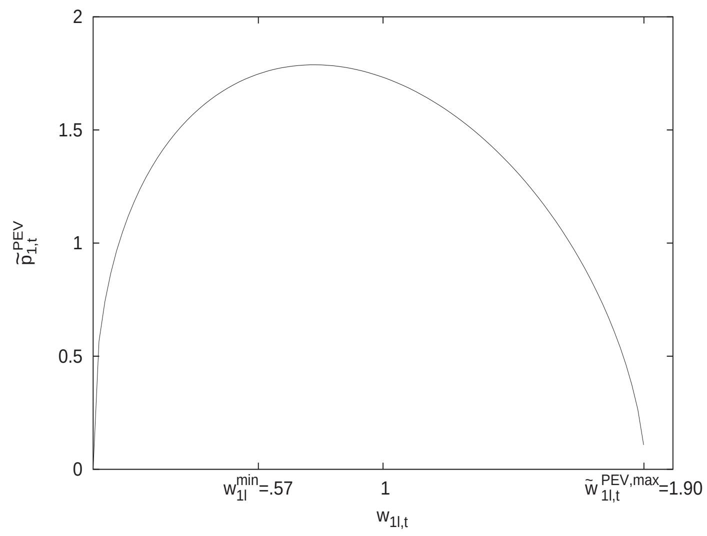
Figure 4.4 shows $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$ for the case where $\tau_{t-1}^{PEV} = 0$ and thus $w_{2,t-1}^{PEV} = 1$.[5] We use in this section the same parameter values as in the preceding section: $s = 0.75, \beta = 0.4, \overline{L}_{1l} = 70,000, \overline{L}_{1h} = 50,000$ and $\overline{L}_2 = 100,000$. Then we have $\tilde{w}_{1l,t}^{PEV,max} = 1.90$ and $\tilde{w}_{1l,t}^{p_1} = 0.76$.

The utility of workers in sector 2 is:[6]

$$\tilde{U}_{2,t}^{PEV}(w_{1l,t}) = \ln\Big(\frac{1}{2}\frac{\tilde{w}_{2,t}^{PEV}}{\tilde{p}_{1,t}^{PEV}}\Big) + \ln\Big(\frac{1}{2}\tilde{w}_{2,t}^{PEV}\Big)$$

[5] This is the case when there was no regulation in $t-1$.
[6] Also under PEV, profits of firms are zero since firms are assumed to be price takers and do not need to worry about equilibrium effects.

Figure 4.4: The typical shape of $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$



As under PEV people consider the wage of workers in sector 2 to be fixed, the characteristics of $\tilde{U}_{2,t}^{PEV}(w_{1l,t})$ depend on $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$.

Lemma 4
$\tilde{U}_{2,t}^{PEV}(w_{1l,t})$ has the following properties:

(i) $\lim_{w_{1l,t}\to 0} \tilde{U}_{2,t}^{PEV}(w_{1l,t}) = \infty$ *and* $\lim_{w_{1l,t}\to \tilde{w}_{1l,t}^{PEV,max}} \tilde{U}_{2,t}^{PEV}(w_{1l,t}) = \infty$.

(ii) The local maximizer $\tilde{w}_{1l,t}^{p_1}$ for $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$ is a local minimizer of $\tilde{U}_{2,t}^{PEV}(w_{1l,t})$ in $(0, \tilde{w}_{1l,t}^{PEV,max})$.

(iii) Workers in sector 2 maximize their utility $\tilde{U}_{2,t}^{PEV}(w_{1l,t})$ if they choose the largest possible wage $\tilde{w}_{1l,t}^{PEV,max}$.

The last point follows from the fact that $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$ is a continuous function in $[w_{1l}^{min}, \tilde{w}_{1l,t}^{PEV,max})$.

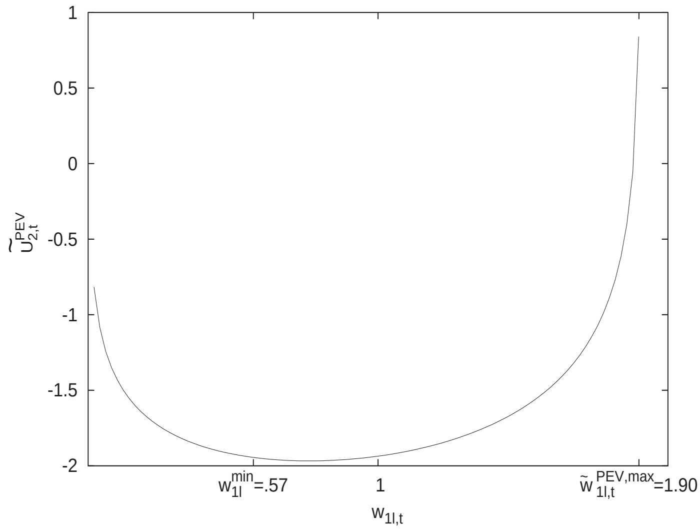
Now we turn to the high-skilled workers of sector 1. Their utility function is:

$$\tilde{U}_{1h,t}^{PEV}(w_{1l,t}) = \ln\Big(\frac{1}{2}\frac{\tilde{w}_{1h,t}^{PEV}}{\tilde{p}_{1,t}^{PEV}}\Big) + \ln\Big(\frac{1}{2}\tilde{w}_{1h,t}^{PEV}\Big)$$

Dividing $\tilde{w}_{1h,t}^{PEV}$ by $\tilde{p}_{1,t}^{PEV}$ we obtain:

$$\frac{\tilde{w}_{1h,t}^{PEV}}{\tilde{p}_{1,t}^{PEV}} = \Big(\frac{1-\beta}{1+\tau_{t-1}^{PEV}}\Big)\Big(\frac{\beta}{w_{1l,t}}\Big)^{\beta}\Big(\frac{\epsilon_t(w_{1l,t})}{\overline{L}_{1h}}\Big)^{\beta} \quad (4.7)$$

Figure 4.5: $\tilde{U}_{2,t}^{PEV}$ with $\tau_{t-1}^{PEV} = 0$



from equations (3.31) and (4.7) we can conclude the following:

Lemma 5
$\tilde{U}_{1h,t}^{PEV}(w_{1l,t})$ has the following properties:

(i) $\tilde{U}_{1h,t}^{PEV}(w_{1l,t})$ *is strictly decreasing in* $w_{1l,t} \in (0, \tilde{w}_{1l,t}^{PEV,max})$.

(ii) The high-skilled workers of sector 1 maximize their utility $\tilde{U}_{1h,t}^{PEV}(w_{1l,t})$ *if they choose the lowest possible wage* w_{1l}^{min}.

The utility function of the low-skilled workers of sector 1 is:

$$\tilde{U}_{1l,t}^{PEV}(w_{1l,t}) = -2\frac{\tilde{L}_{1l,t}^{PEV}}{\overline{L}_{1l}} \ln(s) + \ln(w_{1l,t}) + \ln\left(\frac{w_{1l,t}}{\tilde{p}_{1,t}^{PEV}}\right) + 2\ln(s) - 2\ln(2) \tag{4.8}$$

We obtain the following lemma (for proof see appendix):

Lemma 6
$\tilde{U}_{1l,t}^{PEV}(w_{1l,t})$ has the following properties:

(i) $\lim_{w_{1l,t}\to 0} \tilde{U}_{1l,t}^{PEV}(w_{1l,t}) = \infty$ *and* $\lim_{w_{1l,t}\to \tilde{w}_{1l,t}^{PEV,max}} \tilde{U}_{1l,t}^{PEV}(w_{1l,t}) = \infty$.

(ii) There is one local optimum - which is a minimum - in $(0, \tilde{w}_{1l,t}^{PEV,max})$.

(iii) The low-skilled workers of sector 1 maximize their utility $\tilde{U}_{1l,t}^{PEV}(w_{1l,t})$ *if they choose the largest possible wage* $\tilde{w}_{1l,t}^{PEV,max}$.

Figure 4.6: $\tilde{U}^{PEV}_{1h,t}$ with $\tau^{PEV}_{t-1} = 0$

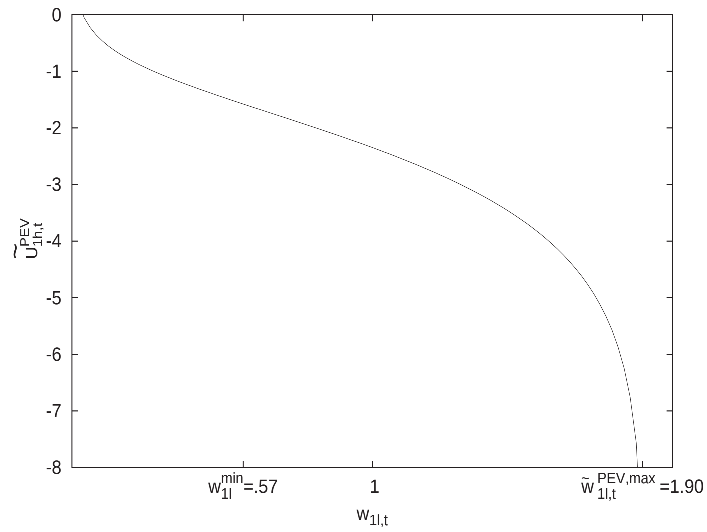
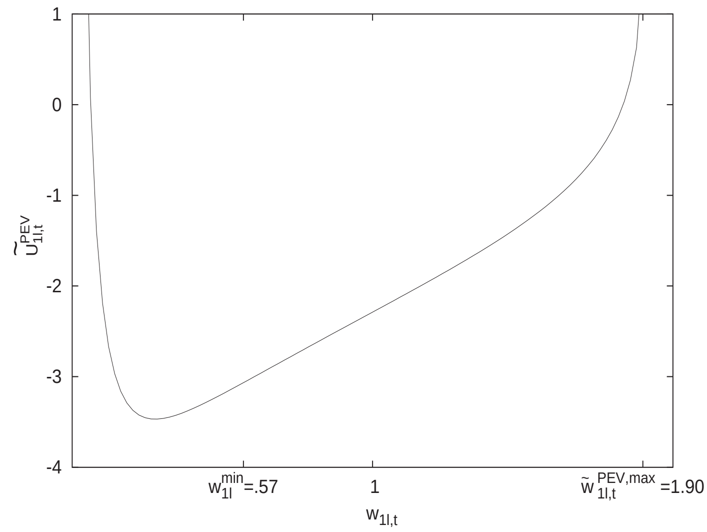


Figure 4.7: $\tilde{U}^{PEV}_{1l,t}$ with $\tau^{PEV}_{t-1} = 0$



Now we can determine the equilibria under PEV. In each round of voting workers in sector 2 and the low-skilled workers of sector 1 choose $\tilde{w}_{1l,t}^{PEV,max}$. Thus the short-run equilibrium in period t is $\hat{w}_{1l,t}^{PEV} = \tilde{w}_{1l,t}^{PEV,max}$. It depends on the tax rate that actually satisfies the state's budget constraint of the previous voting period. To derive the long-run equilibrium we need a starting point for the economy characterized by $E(w_{1l,r})$ with the starting wage $w_{1l,r} \in [w_{1l}^{min}, w_{1l}^{max})$ and the corresponding tax rate τ_r. We obtain the following proposition (for proof see appendix):

Proposition 2 (The Evolution of the Economy under PEV)
Under PEV, the economy evolves according to:

$$\hat{w}_{1l,t}^{PEV} = \frac{2\overline{L}_2 - \frac{1}{(2-s\beta)^t(1+\tau_r)}\overline{L}_2}{s\overline{L}_{1l}} \tag{4.9}$$

$$w_{2,t}^{PEV} = \frac{1}{(2-s\beta)^{t+1}(1+\tau_r)} \tag{4.10}$$

$$\tau_t^{PEV} = (2-s\beta)^{t+1}(1+\tau_r) - 1, \tag{4.11}$$

where $\tau_r < \infty$ is the tax rate that actually satisfies the state's budget constraint before period zero starts.

We next determine whether a crisis will occur in the long-run under PEV.

For $w_{1l,r} \in [w_{1l}^{min}, w_{1l}^{max})$, $\hat{w}_{1l,t}^{PEV}$ converges to $w_{1l}^{max} = \frac{2\overline{L}_2}{s\overline{L}_{1l}}$ as t goes to infinity. As $\hat{w}_{1l,t}^{PEV}$ never exceeds the largest possible value w_{1l}^{max}, the variables $w_{1h,t}^{PEV}$, $w_{2,t}^{PEV}$, $L_{1l,t}^{PEV}$ and $p_{1,t}^{PEV}$ are always economically feasible, no economic collapse occurs, and we can determine an equilibrium E^{PEV*}. Nevertheless, we observe CUTT as $\lim_{t\to\infty} \hat{w}_{1l,t}^{PEV} = w_{1l}^{max}$.

Thus - starting with $w_{1l,r}$ - as t increases, τ_t^{PEV} will become larger than some critical τ_{max}. Therefore, in the case where the economic and political system cannot exceed τ_{max}, CLTT will occur if:

$$(2-s\beta)^{t+1}(1+\tau_r) - 1 > \tau_{max}$$

or if:

$$t > \frac{\ln\left(\frac{1+\tau_{max}}{1+\tau_r}\right)}{\ln(2-s\beta)} - 1$$

Thus, the first voting period T where $\hat{w}_{1l,t}^{PEV}$ "produces" an infeasible tax rate is:

$$T = \left\lfloor \frac{\ln\left(\frac{1+\tau_{max}}{1+\tau_r}\right)}{\ln(2-s\beta)} \right\rfloor \tag{4.12}$$

where $\lfloor\ \rfloor$ denotes the largest possible integer that is smaller than the expression under consideration.

We can summarize our results under the PEV view by the following proposition:

Proposition 3 (The Long-Run Political Equilibrium under PEV)

(i) Under PEV and if CUTT holds, the long-run equilibrium for $w_{1l,r} \in [w_{1l}^{min}, w_{1l}^{max})$ *is given by*

$$\hat{w}_{1l}^{PEV*} = \lim_{t\to\infty} \hat{w}_{1l,t}^{PEV} = w_{1l}^{max}$$

and all low-skilled workers lose their jobs:

$$\Delta^{PEV*} = \lim_{t\to\infty} \Delta_t^{PEV} = \overline{L}_{1l}$$

(ii) If the tax rate is not allowed to exceed τ_{max}*, CLTT occurs and the Condorcet winner of period* T *in which the crisis emerges is*

$$\hat{w}_{1l,T}^{PEV} = \frac{2\overline{L}_2 - \frac{1}{(2-s\beta)^T(1+\tau_r)}\overline{L}_2}{s\overline{L}_{1l}}$$

where

$$T = \left\lfloor \frac{\ln\left(\frac{1+\tau_{max}}{1+\tau_r}\right)}{\ln(2-s\beta)} \right\rfloor$$

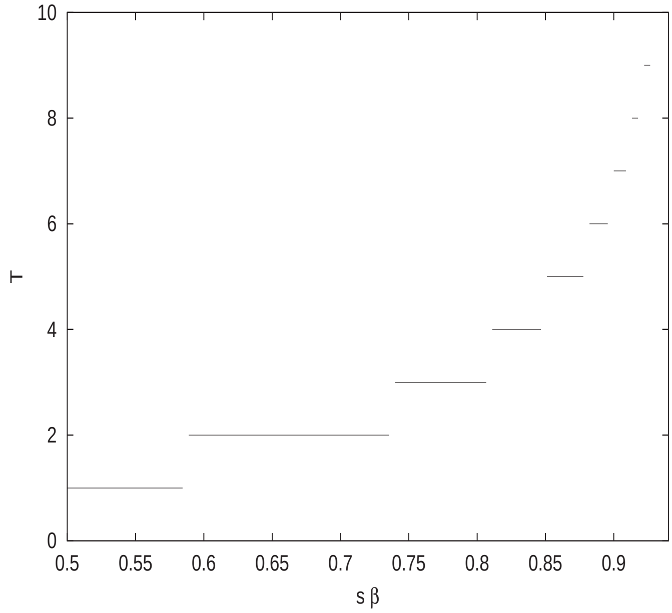
and the number of unemployed workers is:

$$\Delta_T^{PEV} = \overline{L}_{1l}\frac{2(2-s\beta)^2 - 2\frac{1}{(2-s\beta)^{T-1}(1+\tau_r)}}{2(2-s\beta)^2 - 2\frac{1}{(2-s\beta)^{T-1}(1+\tau_r)} + s\beta\frac{1}{(2-s\beta)^{T-1}(1+\tau_r)}},$$

where $\tau_r < \infty$ *is the tax rate that actually satisfies the state's budget constraint before period zero starts.*

In Figure 4.8, T is plotted as a function of $s\beta$ (see equation (4.12)) in a range of $s\beta = [0.50, 0.94]$. We assume $\tau_{max} = 1$ and the market-clearing wage as starting wage, which implies $\tau_r = 0$. For $s\beta \leq 0.58$, T equals 1, i.e. the implementation of the Condorcet winner in period 1 would require a tax rate that exceeds τ_{max}. As $s\beta$ increases, T also increases. The intervals for $s\beta$ in which T stays constant become smaller. Eventually, T goes to infinity as $s\beta$ approaches 1.

Figure 4.8: The collapse period T for $\tau_r = 0$ and $\tau_{max} = 1$



4.3 Comparing Long-Run Political Equilibria of General Equilibrium Voting (GEV) and Partial Equilibrium Voting (PEV)

Proposition 4 summarizes our results and shows that in democracies where voters only take direct effects of regulations into account, strong negative effects from regulations will be experienced and eventually a crisis will occur.

Proposition 4
The Condorcet winner wages satisfy:

$$w_{1l}^{min} = \hat{w}_{1l}^{GEV*} < \hat{w}_{1l,T}^{PEV} < \hat{w}_{1l}^{PEV*},$$

where $\hat{w}_{1l}^{GEV*}$ *denotes the long-run political equilibrium under GEV,* $\hat{w}_{1l,T}^{PEV}$ *the long-run equilibrium under PEV with limited tax tolerance (CLTT), and* $\hat{w}_{1l}^{PEV*}$ *the long-run equilibrium under PEV with unlimited tax tolerance (CUTT). Accordingly, unemployment rates satisfy:*

$$0 = \Delta^{GEV*} < \Delta_T^{PEV} < \Delta^{PEV*},$$

i.e., there is no unemployment under GEV whereas PEV produces unemployment both under CLTT and CUTT.

4.4 Reaction to Crises

Under PEV, we assume first that voters do not learn that their view of the economy is wrong although there is a discrepancy between their expected utility levels and those actually achieved. Nevertheless, at some point in time society enters a crisis because voters as tax payers will recognize that there are large negative general equilibrium effects: Either τ_t approaches infinity and all low-skilled workers in sector 1 are unemployed and production is zero, or the tax rate crosses τ_{max} and workers reduce labor supply or move into the shadow economy (see our concept of a crisis, Definition 1, p. 36). As the gap between gross wages and net wages becomes too large and real wages become too small people will not be willing to accept this.

There are two conceivable reaction patterns to the crisis:

1. People perform ad-hoc measures and - for the moment - give up their assumption of an unchanging tax rate and vote for historical values of $\hat{w}_{1l,t}$ or complementary policy actions (e.g. a reduction of s). They would expect a lower tax rate connected with these measures. But afterwards they return to their former beliefs or other mistaken views about the functioning of the economy. As a consequence, they could find themselves faced with the same crisis.

2. People learn that the principles of their former views are incorrect. They recognize the discrepancy between their beliefs and the actual realized values of the economy's variables. They adopt a new mental framework for thinking about the functioning of the economy and reverse their PEV view in favor of the GEV view. In particular, sector 2 workers may switch to GEV as they become aware of their tax burden and real-wage decline. If this happens, parties offering market-clearing wages and a reduction in taxes will win and the wage in the unregulated economy will emerge as Condorcet winner.

4.5 Interpretation of Results

In order to interpret our results it will be useful to discuss in detail the GEV view first. Then it will become transparent how PEV differs to GEV.

4.5.1 General Equilibrium Voting (GEV)

Under GEV, voters have equations (3.7) to (3.19) in mind when they contemplate about the consequences of the minimum wage's value $w_{1l,t}$ for their utility levels. To achieve an economic understanding of the effects of a changing minimum wage $w_{1l,t}$ on the variables of the model, they start with some $w_{1l,t}$ and consider what happens if $w_{1l,t}$ increases by a certain amount. From this they obtain τ_t^{GEV} and $p_{1,t}^{GEV}$, such that the market-clearing condition (3.19) and the governmental budget constraint (3.17) are fulfilled simultaneously:

$$L_{1l,t}^{GEV}\frac{b_{1l,t}^{GEV}}{2} + L_{1h,t}^{GEV}\frac{b_{1h,t}^{GEV}}{2} + L_{2,t}^{GEV}\frac{b_{2,t}^{GEV}}{2} + \Delta_t^{GEV}\frac{b_{un,t}^{GEV}}{2} = q_{2,t}^{GEV} \tag{4.13}$$

$$(w_{1l,t}L_{1l,t}^{GEV} + w_{1h,t}^{GEV}L_{1h,t}^{GEV} + w_{2,t}^{GEV}L_{2,t}^{GEV})\tau_t^{GEV} = \Delta_t^{GEV}b_{un,t}^{GEV} \tag{4.14}$$

where

$$b_{1l,t}^{GEV} = w_{1l,t}, b_{1h,t}^{GEV} = w_{1h,t}^{GEV}, b_{2,t}^{GEV} = w_{2,t}^{GEV} \quad \text{and} \quad b_{un,t}^{GEV} = sw_{1l,t}$$

We now introduce relative labor costs, which will help to explain the functioning of the economy. The tax rate and the price for good 1 determine the relative labor costs $w_{1l,t}(1+\tau_t)/p_{1,t}$ and $w_{1h,t}(1+\tau_t)/p_{1,t}$ and therefore labor demand in sector 1. For example, if $w_{1l,t}(1+\tau_t)/p_{1,t}$ increases, labor demand for the low-skilled will decrease. [7] As the minimum wage is binding, the low-skilled labor force also decreases. Furthermore, because low-skilled and high-skilled labor are complementary inputs, the demand for high-skilled workers in sector 1 for a given wage level $w_{1h,t}$ decreases as well.[8] Consequently, as the high-skilled labor market in sector 1 is not regulated, the wage level $w_{1h,t}$ declines so that the labor market for high-skilled workers will clear. Of course, a change in $(1+\tau_t)/p_{1,t}$ itself changes labor demand for the high-skilled. If $(1+\tau_t)/p_{1,t}$ goes down, $w_{1h,t}$ goes up and vice versa. Since $p_2 = 1$, relative labor costs in sector 2 are $w_{2,t}(1+\tau_t)$. Again, this labor market is not regulated and thus relative labor costs remain constant, i.e., by the same proportion that $(1+\tau_t)$ changes, $w_{2,t}$ too has to change, but in the opposite direction.

We summarize the concept of relative labor costs in the following definition:

Definition 2 (Relative Labor Costs)
We define relative labor costs for workers in sector 1 as:

$$\frac{w_{1l,t}\cdot(1+\tau_t)}{p_{1,t}} \quad \textit{and} \quad \frac{w_{1h,t}\cdot(1+\tau_t)}{p_{1,t}}$$

and in sector 2 as:

$$\frac{w_{2,t}\cdot(1+\tau_t)}{p_{2,t}}$$

[7] This follows from the profit maximization condition with respect to L_{1l} (see equation (3.12))and the fact that the high-skilled labor market always clears and therefore $L_{1h,t} = \overline{L}_{1h}$ in all periods.

[8] Note that $\partial^2 q_{1,t}/(\partial L_{1h,t}\partial L_{1l,t}) > 0$. If the use of $L_{1l,t}$ decreases, the marginal productivity of $L_{1h,t}$ also decreases. Because $\partial^2 q_{1,t}/\partial(L_{1h,t})^2 < 0$, the use of $L_{1h,t}$ has to decrease for a given wage level if firms want to maximize their profits.

Relative labor costs determine the labor demand of firms in the respective labor market. In sector 1, labor demand of firms for one skill level additionally depends on the other skill level's employment. Furthermore, in sector 2 and for the high-skilled workers of sector 1, relative labor costs always have to adapt for the clearance of the respective labor market. That is, relative labor costs in this markets remain constant.

The perceived relative labor costs are defined accordingly.

We can draw the conclusions of Proposition 1 (The Long-Run Political Equilibrium under GEV) mainly from equations (4.13) and (4.14) intuitively without explicitly computing the results.

In equilibrium, unemployment increases if the minimum wage $w_{1l,t}$ goes up. To see this, suppose that - starting from an equilibrium situation - unemployment would not increase if $w_{1l,t}$ increased. Then $L_{1l,t}^{GEV}$ would have to remain constant or increase. Hence, $(1+\tau_t^{GEV})/p_{1,t}^{GEV}$ would have to fall by at least the same proportion as $w_{1l,t}$ increased. But if $(1+\tau_t^{GEV})/p_{1,t}^{GEV}$ declined while $L_{1l,t}^{GEV}$ did not fall, aggregate demand of the high-skilled for good 2 would increase and $w_{1h,t}^{GEV}$ would have to rise as $L_{1h,t}^{GEV} = \overline{L}_{1h}$. To complete the argument we have to distinguish two cases: First, a constant or falling tax rate and second, an increasing tax rate. In the first case, i.e. in the case of a constant or decreasing tax rate, $w_{2,t}^{GEV}$ and therefore aggregate demand of sector 2 workers for good 2 would at least remain constant but never fall, because $w_{2,t}^{GEV} = 1/(1+\tau_t^{GEV})$. Furthermore, if an increasing $w_{1l,t}$ caused constant or decreasing unemployment, aggregate demand for good 2 of all low-skilled would go up. Hence, an increasing $w_{1l,t}$ would correspond to an increasing aggregate demand of all voter groups for good 2 as long as τ_t^{GEV} would not increase. Given that the right hand side of (4.13) always equals $q_{2,t}^{GEV} = \overline{L}_2$, it follows that a situation where unemployment decreases or remains constant while $w_{1l,t}$ increases and τ_t^{GEV} does not, cannot be an equilibrium. In the second case, i.e. if τ_t^{GEV} increased, $p_{1,t}^{GEV}$ also would have to increase since $(1+\tau_t^{GEV})/p_{1,t}^{GEV}$ would have to decline in the case of not increasing unemployment. If we look at the first goods market:

$$\left(L_{1l,t}^{GEV} \frac{b_{1l,t}^{GEV}}{2} + L_{1h,t}^{GEV} \frac{b_{1h,t}^{GEV}}{2} + L_{2,t}^{GEV} \frac{b_{2,t}^{GEV}}{2} + \Delta_t^{GEV} \frac{b_{un,t}^{GEV}}{2} \right) / p_{1,t}^{GEV} = q_{1,t}^{GEV} \tag{4.15}$$

we can recognize that an increasing $p_{1,t}^{GEV}$ together with an increasing or constant $q_{1,t}^{GEV}$ (non-decreasing employment of the low-skilled workers) would imply an increasing numerator on the left hand side of equation (4.15) to guarantee market-clearing in the first goods market. Since $q_{2,t}^{GEV}$ remains constant, equation (4.13) would not hold and goods market 2 would not clear. Thus, a situation where a rising $w_{1l,t}$ corresponds to non-increasing unemployment and an increasing tax rate cannot be an equilibrium, too.

Therefore, independent of the changes in τ_t^{GEV}, unemployment will always increase when $w_{1l,t}$ goes up.

If unemployment increases when the minimum wage goes up, then output in sector 1 will decrease (see equations (3.1) and (3.15)), i.e., good 1 will become scarcer. Hence, its price $p_{1,t}^{GEV}$ must rise if $w_{1l,t}$ increases.

Furthermore, since unemployment increases when $w_{1l,t}$ rises and thus $\Delta_t^{GEV}\frac{b_{un,t}^{GEV}}{2}$ also rises, the sum $L_{1l,t}^{GEV}\frac{b_{1l,t}^{GEV}}{2} + L_{1h,t}^{GEV}\frac{b_{1h,t}^{GEV}}{2} + L_{2,t}^{GEV}\frac{b_{2,t}^{GEV}}{2}$ has to fall to satisfy equation (4.13). But then $(w_{1l,t}L_{1l,t}^{GEV} + w_{1h,t}^{GEV}L_{1h,t}^{GEV} + w_{2,t}^{GEV}L_{2,t}^{GEV})$ also declines and therefore τ_t^{GEV} has to rise according to equation (4.14). Consequently, the tax rate increases monotonically in $w_{1l,t}$. Since relative labor costs $w_{2,t}^{GEV}(1+\tau_t^{GEV})$ in sector 2 have to remain constant as the labor market clears, this means that the nominal wage of sector 2 workers declines when $w_{1l,t}$ increases.

The question arises whether $w_{1l,t}$ can become infeasible. If we look at equation (4.13), we recognize that this must be the case from a certain value of $w_{1l,t}$ on, denoted by w_{1l}^{max}. The reason for this is that from this point on - as $w_{1l,t}$ is increased exogenously - the demand of the low-skilled will exceed $q_{2,t}^{GEV} = \overline{L}_2$ even if all low-skilled are unemployed since unemployed individuals receive $sw_{1l,t}$.[9] Then the market for good 2 could only clear if $L_{1l,t}^{GEV}$ was negative, which is not possible. Furthermore, at the critical level w_{1l}^{max}, the aggregate demand for good 2 of the high-skilled workers and workers of sector 2 has to be zero because the goods market in sector 2 clears. Thus, at w_{1l}^{max}, $w_{1h,t}^{GEV}$ and $w_{2,t}^{GEV}$ have to be zero. For a given non-negative value of $L_{1l,t}^{GEV}$, $w_{1h,t}^{GEV} = 0$ can only hold if $\lim_{w_{1l,t}\to w_{1l}^{max}}(1+\tau_t^{GEV})/p_{1,t}^{GEV} = \infty$ (see equation (3.13)). The result is that, because of equation (3.12), the employment of the low-skilled is also zero. We can conclude, therefore, that for $w_{1l,t} = w_{1l}^{max}$, where all low-skilled alone consume all of good 2, all low-skilled are unemployed and $(1+\tau_t^{GEV})/p_{1,t}^{GEV} = \infty$.

Thus, output in sector 1 is zero, and for clearance of this good market demand has to be zero, which implies $\lim_{w_{1l,t}\to w_{1l}^{max}} p_{1,t}^{GEV} = \infty$. Since $\lim_{w_{1l,t}\to w_{1l}^{max}}(1+\tau_t^{GEV})/p_{1,t}^{GEV} = \infty$, it follows that $\lim_{w_{1l,t}\to w_{1l}^{max}}(1+\tau_t^{GEV}) = \infty$. The latter can also been seen from the fact that $w_{2,t}^{GEV}$ has to be zero and according to equation (3.14) $w_{2,t}^{GEV} = 1/(1+\tau_t^{GEV})$.

Summarizing the analysis, we can say that an increasing minimum wage has two effects: a negative effect on total wealth and a redistributive effect in favor of the low-skilled.

Increasing minimum wages increase unemployment, lower total output and therefore reduce the total wealth of society. This is represented by an increasing price for good 1 such that real wages become less and less not only for the high-skilled of sector 1 and workers of sector 2 but also - at least when $w_{1l,t}$ is big enough - for the low-skilled

[9]For w_{1l}^{max} the demand of the low-skilled for good 2 is equal to $q_{2,t}^{GEV} = \overline{L}_2$.

of sector 1. Furthermore, setting a higher minimum wage increasingly redistributes the remaining wealth in favor of the low-skilled workers. This is represented by an increasing tax rate. In the extreme case where all wealth is allocated to the low-skilled workers, the tax rate must be infinitely large to ensure that all other groups channel all their gross earnings to the low-skilled via the state's tax regime.

The exact analytic result of voters' reasoning processes is given by equations (3.20) to (3.27). Clearly, workers of sector 2 and the high-skilled workers of sector 1 prefer the lowest possible minimum wage because an increase in $w_{1l,t}$ monotonically lowers their net wages and monotonically increases the price of good 1. The low-skilled have to consider a trade-off between a higher $p_{1,t}^{GEV}$ and increasing unemployment on the one hand, and higher net wages and unemployment benefits on the other. Therefore for some values of s and β they will prefer a minimum wage that exceeds w_{1l}^{min}.

4.5.2 Partial Equilibrium Voting (PEV)

Under PEV, the same reasoning process by agents occurs, but with two important differences. Both the nominal wage in sector 2 $\tilde{w}_{2,t}^{PEV}$ and the tax rate $\tilde{\tau}_t^{PEV}$ are assumed to stay constant, i.e., the governmental budget constraint (see equation (3.17)) is simply ignored.

Voters look at the second goods market and perform their computations concerning the price of good 1 such that goods market 2 clears. From these considerations they not only derive the price of good 1 but also their wages. This enables them to compute their Marshallian demand functions, which they assume will be satisfied. Thus, voters only indirectly observe output in sector 1 through the assumption that their Marshallian demand resulting from perceived prices and wages can be satisfied. But under PEV this assumption does not hold, since they do not take into account general equilibrium repercussions from the economy resulting from higher unemployment and the attendant change of the tax rate. This ignorance is represented by their assumption of a constant tax rate.

The key insight is the following: As voters assume that $\tilde{w}_{2,t}^{PEV}$ and $\tilde{\tau}_t^{PEV}$ remain constant, the demand of workers of sector 2 for the second good would also remain constant. If $w_{1l,t}$ rises, the demand of low-skilled workers for the second good must increase from a certain value of $w_{1l,t}$ on. In order to obtain market-clearing in sector 2, the demand of high-skilled workers for the second good would have to decline in the eyes of the voters, which would require a decline of $\tilde{w}_{1h,t}^{PEV}$. A lower $\tilde{w}_{1h,t}^{PEV}$ would have to be in turn be accompanied by a lower price for good 1. This follows from the continuity of the price function and the arguments we present in the next paragraph.

Since $\tilde{p}_{1,t}^{PEV}$ would decline under PEV, workers in sector 2 perceive that their utility increases with a rising $w_{1l,t}$ since their nominal net wages would remain constant. We observe that workers in sector 2 do not anticipate that their own demand for sector 2 goods will decline since they assume $\tilde{w}_{2,t}^{PEV}$ and $\tilde{\tau}_t^{PEV}$ to be constant. This failure to recognize general equilibrium effects translates into a mistaken view about price reactions through the market-clearing in sector 2 when $w_{1l,t}$ changes. An important interpretation of these considerations is that, since $\tilde{w}_{2,t}^{PEV}$ varies with $\tilde{\tau}_t^{PEV}$ and the GEV outcome would result if $\tilde{\tau}_t^{PEV}$ was allowed to adjust, the only misconception on the voters' part is their ignorance concerning the governmental budget constraint.

Under GEV, an increase in $w_{1l,t}$ leads to higher unemployment and therefore to an increasing tax rate. The increase in $\tilde{\tau}_t^{PEV}$ guarantees the necessary decrease in aggregate demand for good 2 by the high-skilled in sector 1 and workers of sector 2 while $w_{1l,t}$ increases and leads to a growing demand for good 2 by low-skilled workers. Since under PEV both $\tilde{\tau}_t^{PEV}$ and $\tilde{w}_{2,t}^{PEV}$ are perceived to remain constant, the necessary decrease in aggregate demand in favor of the low-skilled could only be secured by decreasing demand by the high-skilled of sector 1. In the critical case where all of good 2 would be allocated to the low- skilled and the workers of sector 2, $\tilde{w}_{1h,t}^{PEV}$ would have to be zero. The corresponding minimum wage would be $\tilde{w}_{1l}^{PEV,max}$. But if $\tilde{w}_{1h,t}^{PEV}$ was zero, this would mean according to equation (3.13) that either $\tilde{L}_{1l,t}^{PEV} = 0$ or $(1 + \tilde{\tau}_t^{PEV})/\tilde{p}_{1,t}^{PEV} = \infty$, which would be equivalent because the maximum value $\tilde{w}_{1l}^{PEV,max}$ of $w_{1l,t}$ would be finite (see equation (3.12)). Consequently, as $\tilde{\tau}_t^{PEV}$ is presumed to remain constant, $\tilde{p}_{1,t}^{PEV}$ would have to decline from a certain value of $w_{1l,t}$ on and would approach zero if $w_{1l,t}$ approached $\tilde{w}_{1l}^{PEV,max}$. Clearly, this would be the preferred minimum wage for the low- skilled workers of sector 1 and the workers of sector 2 since their real wages would approach infinity while the real wage of the high-skilled would be zero.[10] Note that the perceived price for good 1 does not reflect the scarcity of good 1 correctly because with an unchanging $\tilde{\tau}_t^{PEV}$ it has to guarantee redistribution to the low-skilled in the second goods market. Furthermore, we can conclude that $\tilde{w}_{1l}^{PEV,max}$ is smaller than w_{1l}^{max} because under PEV the aggregate demand by workers from sector 2 cannot diminish since $\tilde{w}_{2,t}^{PEV}$ is assumed to remain constant.

If we look at the political outcome under PEV we find that the crisis is self-enforcing: The higher the last period's equilibrium tax rate is the higher the minimum wage the Median-voters prefer in the present period. The short-run political equilibrium under PEV, $\hat{w}_{1l,t}^{PEV}$, strictly increases in the last period's tax rate $\tau_{t-1}^{PEV} = (2 - s\beta)^t(1 + \tau_r) - 1$ (see Proposition 2 "The Evolution of the Economy under PEV") which in turn strictly

[10]The high-skilled workers´ consumption of good 2 would be zero. Thus they would realize the lowest possible utility level of zero (see equation (3.3)) and accordingly their real wages would have to be zero.

rises in t. One possible interpretation is that with an increasing tax rate the perceived nominal wage in sector 2, $\tilde{w}_{2,t}^{PEV}$, decreases. Hence - in the perception of voters - more wealth can be redistributed to the low-skilled workers before their real demand for good 2 exceeds output in the second sector and the economy collapses. The maximum value for the minimum wage would increase and therefore the value of the Condorcet winner $\hat{w}_{1l,t}^{PEV}$ in the perspective period.

Chapter 5

Variation: Partial Equilibrium Voting when the First Market is Cleared (PEV1)

In this chapter we analyze the political outcomes when voters take the same view as described in Section 3.3.1.2 (PEV) but with one difference. They assume clearance of the first goods market, i.e., they clear the goods market of the regulated sector. We refer to this view as PEV1.

The clearance of the first goods market can be justified by voters' assumption that nothing changes in the unregulated sector. Therefore, voters completely focus on the first sector.

In this case, it can be shown that they correctly anticipate a rising price for good 1. This assures market-clearing in spite of a decreasing output in sector 1. Under PEV1, the high-skilled workers of sector 1 will favor a minimum wage as high as possible since they perceive higher nominal wages whereas workers in sector 2 will prefer the market-clearing minimum wage. The latter fact follows from higher prices in sector 1 that lower the real wages of voters in sector 2.

The following analysis will show that two voter groups, namely the low-skilled and the high-skilled workers of sector 1, prefer a minimum wage as high as possible. Therefore, the political process under PEV1 may also generate high unemployment and low output and hence, may trigger a crisis.

5.1 Perceived Market Equilibria under Partial Equilibrium Voting 1 (PEV1)

As above, voters assume constancy of sector-2 variables and the tax rate. Therefore they take into account the following equations describing sector-1 behavior of the economy:

$$
\begin{aligned}
w_{1l,t}(1+\tau_t) &= p_{1,t}\beta\Big(\frac{L_{1h,t}}{L_{1l,t}}\Big)^{(1-\beta)} \\
w_{1h,t}(1+\tau_t) &= p_{1,t}(1-\beta)\Big(\frac{L_{1l,t}}{L_{1h,t}}\Big)^{\beta} \\
L_{1h,t} &= \overline{L}_{1h} \\
\Delta_t &= \overline{L}_{1l} - L_{1l,t}
\end{aligned}
$$

Under PEV1 they clear goods market 1 to compute the market equilibrium:

$$L_{1l,t}c_{1,t}^{1l} + L_{1h,t}c_{1,t}^{1h} + L_{2,t}c_{1,t}^{2} + \Delta_t c_{1,t}^{un} = q_{1,t}$$

Since the governmental budget constraint is ignored by voters, solving this system of five equations yields their perceived equilibrium $\tilde{E}_t^{PEV1}(w_{1l,t})$:

$$
\begin{aligned}
\tilde{\tau}_t^{PEV1}(w_{1l,t}) &= \tau_{t-1}^{PEV1} && (5.1)\\
\tilde{w}_{1h,t}^{PEV1}(w_{1l,t}) &= \frac{(1-\beta)(sw_{1l,t}\overline{L}_{1l} + w_{2,t-1}^{PEV1}\overline{L}_2)}{(s\beta + 2\tau_{t-1}^{PEV1}+1)\overline{L}_{1h}} && (5.2)\\
\tilde{w}_{2,t}^{PEV1}(w_{1l,t}) &= \frac{1}{1+\tau_{t-1}^{PEV1}} && (5.3)\\
\tilde{p}_{1,t}^{PEV1}(w_{1l,t}) &= \Big(\frac{sw_{1l,t}\overline{L}_{1l} + w_{2,t-1}^{PEV1}\overline{L}_2}{(s\beta + 2\tau_{t-1}^{PEV1}+1)w_{2,t-1}^{PEV1}\overline{L}_{1h}}\Big)^{1-\beta}\Big(\frac{(1+\tau_{t-1}^{PEV1})w_{1l,t}}{\beta}\Big)^{\beta} && (5.4)\\
\tilde{L}_{1l,t}^{PEV1}(w_{1l,t}) &= \frac{\beta(sw_{1l,t}\overline{L}_{1l} + w_{2,t-1}^{PEV1}\overline{L}_2)}{(s\beta + 2\tau_{t-1}^{PEV1}+1)w_{1l,t}} && (5.5)\\
\tilde{L}_{1h,t}^{PEV1}(w_{1l,t}) &= \overline{L}_{1h} && (5.6)\\
\tilde{L}_{2,t}^{PEV1}(w_{1l,t}) &= \overline{L}_{2} && (5.7)\\
\tilde{\Delta}_t^{PEV1}(w_{1l,t}) &= \overline{L}_{1l} - \frac{\beta(sw_{1l,t}\overline{L}_{1l} + w_{2,t-1}^{PEV1}\overline{L}_2)}{(s\beta + 2\tau_{t-1}^{PEV1}+1)w_{1l,t}} && (5.8)
\end{aligned}
$$

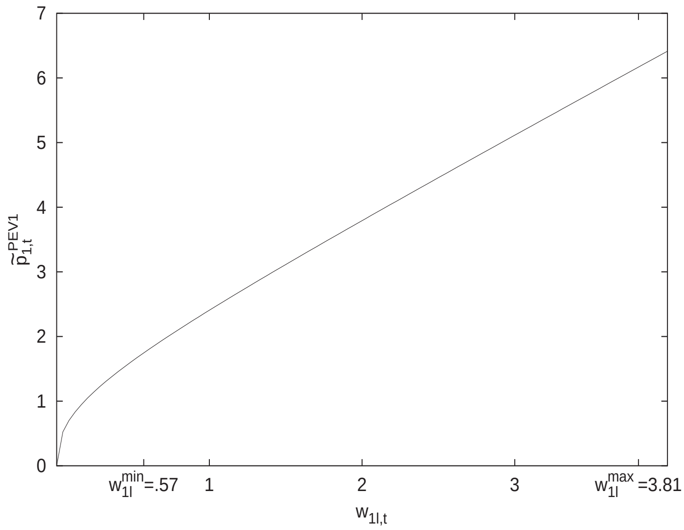
Note that under PEV1 the solution is perceived to be economically feasible for every value of $w_{1l,t}$ not smaller than w_{1l}^{min}.

5.2 Political Equilibria under Partial Equilibrium Voting 1 (PEV1)

5.2.1 Perceived Utility Functions

First it is useful to note that $\tilde{p}_{1,t}^{PEV1}$ strictly increases in $w_{1l,t}$, as can be seen directly from equation (5.4). We illustrate our results using the same parameter values as in Chapter 4: $s = 0.75, \beta = 0.4, \overline{L}_{1l} = 70,000, \overline{L}_{1h} = 50,000, \overline{L}_2 = 100,000$ and $\tau_{t-1}^{PEV1} = 0$. Figure 5.1 shows $\tilde{p}_{1,t}^{PEV1}$ for these values.

Figure 5.1: $\tilde{p}_{1,t}^{PEV1}$ with $\tau_{t-1}^{PEV1} = 0$



The perceived utility function of workers in sector 2 is:

$$\tilde{U}_{2,t}^{PEV1}(w_{1l,t}) = \ln\Big(\frac{1}{2}\frac{\tilde{w}_{2,t}^{PEV1}}{\tilde{p}_{1,t}^{PEV1}}\Big) + \ln\Big(\frac{1}{2}\tilde{w}_{2,t}^{PEV1}\Big)$$

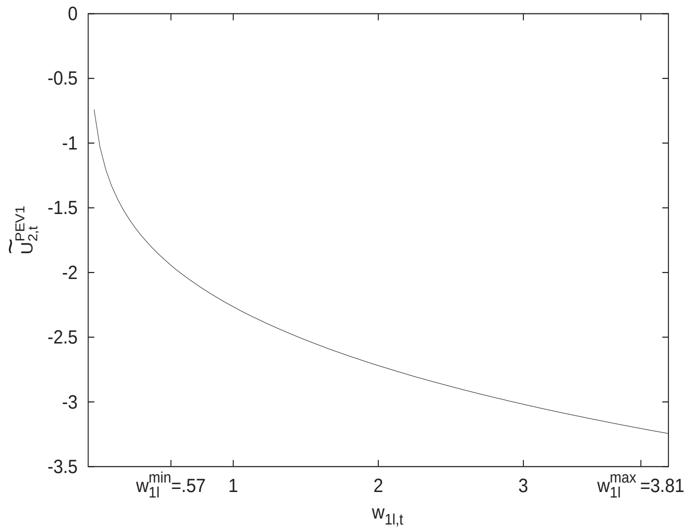
Since wages of sector 2 workers are assumed to remain constant, the characteristics of $\tilde{U}_{2,t}^{PEV1}(w_{1l,t})$ depend on $\tilde{p}_{1,t}^{PEV1}(w_{1l,t})$.

Lemma 7
$\tilde{U}_{2,t}^{PEV1}(w_{1l,t})$ has the following properties for $w_{1l,t} > 0$:

(i) $\tilde{U}_{2,t}^{PEV1}(w_{1l,t})$ strictly decreases in $w_{1l,t}$.

(ii) Workers in sector 2 maximize their utility $\tilde{U}_{2,t}^{PEV1}(w_{1l,t})$ if they choose the lowest possible wage w_{1l}^{min}.

Figure 5.2: $\tilde{U}_{2,t}^{PEV1}$ with $\tau_{t-1}^{PEV1} = 0$



As the high-skilled workers' perceived utility function we have:

$$\tilde{U}_{1h,t}^{PEV1}(w_{1l,t}) = \ln\Big(\frac{1}{2}\frac{\tilde{w}_{1h,t}^{PEV1}}{\tilde{p}_{1,t}^{PEV1}}\Big) + \ln\Big(\frac{1}{2}\tilde{w}_{1h,t}^{PEV1}\Big)$$

We obtain the following lemma (for proof see appendix):

Lemma 8
$\tilde{U}_{1h,t}^{PEV1}(w_{1l,t})$ has the following properties for $w_{1l,t} > 0$:

(i) $\lim_{w_{1l,t}\to 0} \tilde{U}_{1h,t}^{PEV1}(w_{1l,t}) = \infty$ *and* $\lim_{w_{1l,t}\to\infty} \tilde{U}_{1h,t}^{PEV1}(w_{1l,t}) = \infty$.

(ii) There exists one local optimum. This optimum is a minimum and we denote the minimizer by $\tilde{w}_{1l,t}^{PEV1,min_{1h}}$:

$$\tilde{w}_{1l,t}^{PEV1,min_{1h}} = \frac{1}{(1+\tau_{t-1}^{PEV1})s}\beta\frac{\overline{L}_2}{\overline{L}_{1l}} = \frac{1}{(1+\tau_{t-1}^{PEV1})s}w_{1l}^{min}$$

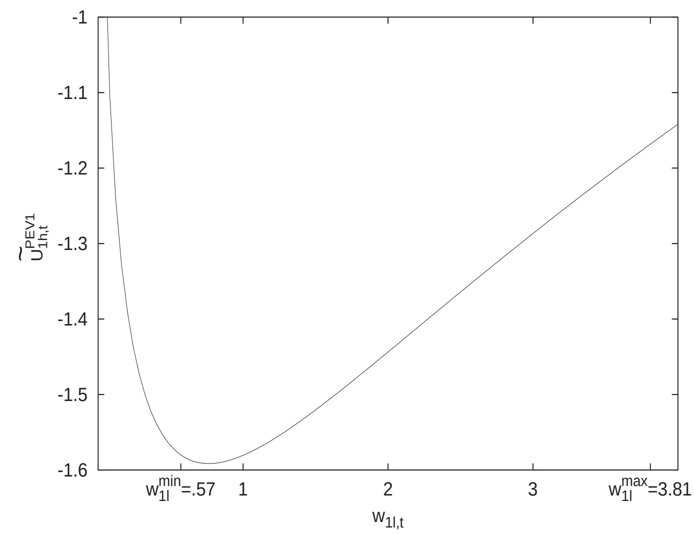
This minimizer is larger than w_{1l}^{min} if $\tau_{t-1}^{PEV1} < \frac{1-s}{s}$.

Finally, we analyze the perceived utility functions of low-skilled workers in the first sector:

$$\tilde{U}_{1l,t}^{PEV1}(w_{1l,t}) = -2\frac{\tilde{L}_{1l,t}^{PEV1}}{\overline{L}_{1l}}\ln(s) + \ln(w_{1l,t}) + \ln\Big(\frac{w_{1l,t}}{\tilde{p}_{1,t}^{PEV1}}\Big) + 2\ln(s) - 2\ln(2)$$

We obtain the following results (for proof see appendix):

Figure 5.3: $\tilde{U}^{PEV1}_{1h,t}$ with $\tau^{PEV1}_{t-1} = 0$



Lemma 9
$\tilde{U}^{PEV1}_{1l,t}(w_{1l,t})$ has the following properties for $w_{1l,t} > 0$ (see also Figure 5.4, p. 61):

(i) $\lim_{w_{1l,t}\to 0} \tilde{U}^{PEV1}_{1l,t}(w_{1l,t}) = \infty$ *and* $\lim_{w_{1l,t}\to\infty} \tilde{U}^{PEV1}_{1l,t}(w_{1l,t}) = \infty$.

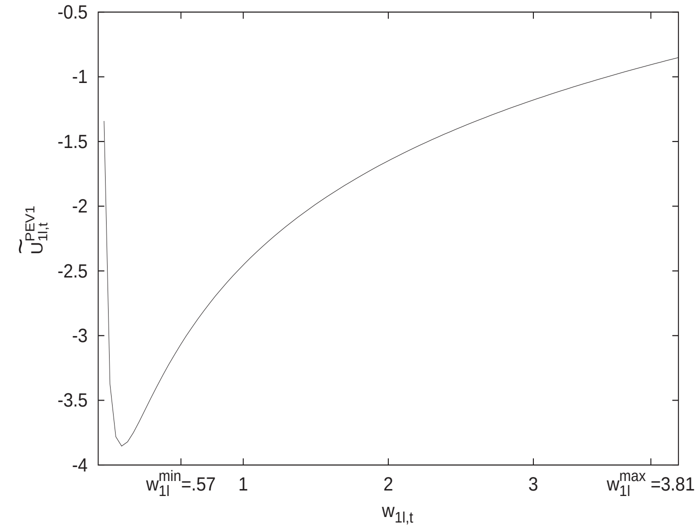
(ii) There exists one local optimum. This optimum is a minimum and we denote the minimizer by $\tilde{w}^{PEV1,min_{1l}}_{1l,t}$. Depending on τ^{PEV1}_{t-1}, s, and β, $\tilde{w}^{PEV1,min_{1l}}_{1l,t}$ can be smaller or larger than w^{min}_{1l}.

5.2.2 Short-Run Political Equilibria

Under PEV1 we observe that voters do not perceive the possibility of an economic collapse. They expect economically feasible outcomes for all values of $w_{1l,t}$ exceeding w^{min}_{1l}. Without further restrictions the political process would immediately generate a crisis because the low-skilled and high-skilled workers of sector 1 would vote for a minimum wage that is as high as possible. Note that there is no reason why minimum wage proposals should be restricted to wages lower than w^{max}_{1l}. Since $\tilde{U}^{PEV1}_{1h,t}(w_{1l,t}) \to \infty$ and $\tilde{U}^{PEV1}_{1l,t}(w_{1l,t}) \to \infty$ for $w_{1l,t} \to \infty$ there will be a value $\hat{w}_{1l,t}$ such that $\tilde{U}^{PEV1}_{1h,t}(\hat{w}_{1l,t}) > \tilde{U}^{PEV1}_{1h,t}(w^{min}_{1l})$ and $\tilde{U}^{PEV1}_{1l,t}(\hat{w}_{1l,t}) > \tilde{U}^{PEV1}_{1l,t}(w^{min}_{1l})$.

In the following, we assume that voters have the right to appeal to a constitutional court when they perceive an equilibrium with real wages that cannot satisfy their subjective minimal consumption level. The constitutional court uses the GEV view to decide on the appeal. According to the minimal consumption level the court wants to guarantee,

Figure 5.4: $\tilde{U}^{PEV1}_{1l,t}$ with $\tau^{PEV1}_{t-1} = 0$



it announces a maximum value $\bar{w}_{1l} > w_{1l}^{min}$ for the minimum wage that cannot be exceeded. Nevertheless, we assume that the judges will be unwilling to impose too much of a restriction on the political process. Thus $\bar{w}_{1l}$ will be large enough to generate a crisis (CLTT). On the other hand, the court has to avoid an economic collapse and therefore chooses a $\bar{w}_{1l}$ that is smaller than w_{1l}^{max}.

Under PEV1, workers of sector 2 will appeal to the court since without restrictions all other voter groups will vote for minimum wages that are as high as possible. Therefore, the short-run equilibrium that occurs will depend on the announced level of $\bar{w}_{1l}$. In the following, the short-run outcomes of the political process are discussed.

Market-Clearing Outcomes Since workers in sector 2 always prefer the market-clearing wage (see Lemma 7), the market-clearing outcome obtains in the short-run if just one group of sector 1 workers also votes for w_{1l}^{min}. If we consider the properties of $\tilde{U}^{PEV1}_{1h,t}$ and $\tilde{U}^{PEV1}_{1l,t}$ (see Lemmas 8 and 9), we recognize that both utility functions have the same structure in terms of optimal decisions. They are both U-shaped with a minimizer that could be equal to w_{1l}^{min} or smaller or larger than w_{1l}^{min}. Figures 5.3 and 5.4 represent the last two cases. Figure 5.3 shows the case where $\tilde{w}_{1l,t}^{PEV1,min_{1h}}$ exceeds w_{1l}^{min}. Thus, we can find a critical level of $w_{1l,t}$, denoted by $\tilde{w}_{1l,t}^{crit,1h}$, which satisfies $\tilde{U}^{PEV1}_{1h,t}(\tilde{w}_{1l,t}^{crit,1h}) = \tilde{U}^{PEV1}_{1h,t}(w_{1l}^{min})$ and $\tilde{w}_{1l,t}^{crit,1h} > w_{1l}^{min}$ and for which a maximum value $\bar{w}_{1l}$ that is smaller than $\tilde{w}_{1l,t}^{crit,1h}$ would generate the market-clearing outcome in the short-run, because $\tilde{U}^{PEV1}_{1h,t}(w_{1l}^{min})$ would be larger than $\tilde{U}^{PEV1}_{1h,t}(\bar{w}_{1l})$. Figure 5.4 shows the case where the utility minimizer is smaller than w_{1l}^{min}. Therefore, the critical wage level is smaller than w_{1l}^{min} and the corresponding voter group will vote for any wage level exceeding the minimum wage.

The values of the critical wage levels for the high-skilled workers and low-skilled workers of sector 1, $\tilde{w}_{1l,t}^{crit,1h}$ and $\tilde{w}_{1l,t}^{crit,1l}$, are defined by $\tilde{U}_{i,t}^{PEV1}(\tilde{w}_{1l,t}^{crit,i}) = \tilde{U}_{i,t}^{PEV1}(w_{1l}^{min})$ and $\tilde{w}_{1l,t}^{crit,i} \neq w_{1l}^{min}$ if $\tilde{w}_{1l,t}^{PEV1,min_i} \neq w_{1l}^{min}$, and $\tilde{w}_{1l,t}^{crit,i} = w_{1l}^{min}$ if $\tilde{w}_{1l,t}^{PEV1,min_i} = w_{1l}^{min}$ $(i = 1h, 1l)$. They depend on a vector of parameters which we will denote by ν. These parameters are τ_{t-1}^{PEV1}, s, β, $\overline{L}_{1l}$, $\overline{L}_{1h}$, and $\overline{L}_2$, where only τ_{t-1}^{PEV1} could vary in the voting process. Therefore, we can define $\nu := (\tau_{t-1}^{PEV1}, \bar{\nu}) := (\tau_{t-1}^{PEV1}, s, \beta, \overline{L}_{1l}, \overline{L}_{1h}, \overline{L}_2)$. The set $\mathcal{M}$ of all possible parameter vectors is

$$\mathcal{M} := \left\{ \left(\tau_{t-1}^{PEV1}, s, \beta, \overline{L}_{1l}, \overline{L}_{1h}, \overline{L}_2\right) \middle| \tau_{t-1}^{PEV1} \in [0, \infty), s \in (0,1], \beta \in (0,1), \overline{L}_i / (\sum_i \overline{L}_i) < 1/2 \right\}.$$

Since the critical wage levels will be larger than w_{1l}^{min} if and only if the utility minimizers are larger than w_{1l}^{min}, we obtain the following proposition from Lemmas 8 and 9.

Proposition 5

(i) For $\tau_{t-1}^{PEV1} < \frac{1-s}{s}$, the critical wage level $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$ is larger than w_{1l}^{min}. Hence, if $\bar{w}_{1l} < \tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$, the market-clearing outcome w_{1l}^{min} obtains as a short-run political equilibrium. [1]

(ii) For some combinations of τ_{t-1}^{PEV1}, s, and β, the critical wage level $\tilde{w}_{1l,t}^{crit,1l}(\tau_{t-1}^{PEV1}, \bar{\nu})$ is larger than w_{1l}^{min}. Hence, if $\bar{w}_{1l} < \tilde{w}_{1l,t}^{crit,1l}(\tau_{t-1}^{PEV1}, \bar{\nu})$, the market-clearing outcome w_{1l}^{min} obtains as a short-run political equilibrium.

Crisis Outcomes The necessary condition for the market-clearing outcome is that for at least one group of sector 1 workers the utility minimizer is larger than w_{1l}^{min}. Additionally, to guarantee the market-clearing outcome, $\bar{w}_{1l}$ has to be smaller than the corresponding critical wage level.

If and only if $\bar{w}_{1l}$ is larger than the critical levels for both groups in sector 1, the crisis outcome $\bar{w}_{1l}$ will obtain. The next proposition states that this can be the case for some constellations ν.

Proposition 6

For some $\nu \in \mathcal{M}$, $\tilde{w}_{1l,t}^{crit,1h}(\nu) < w_{1l}^{max}$ and $\tilde{w}_{1l,t}^{crit,1l}(\nu) < w_{1l}^{max}$. Hence, if $\bar{w}_{1l} \geq \tilde{w}_{1l,t}^{crit,1h}(\nu)$ and $\bar{w}_{1l} \geq \tilde{w}_{1l,t}^{crit,1l}(\nu)$, the crisis outcome $\bar{w}_{1l}$ obtains in the short-run.

The crisis outcome will obtain independently of the level of $\bar{w}_{1l}$ if $\tilde{w}_{1l,t}^{PEV1,min_{1h}} \leq w_{1l}^{min}$ and $\tilde{w}_{1l,t}^{PEV1,min_{1l}} \leq w_{1l}^{min}$.

[1] We assume that in the case of indifference voters will choose the larger value as minimum wage.

Examples The following examples in Table 5.1 verify and illustrate Propositions 5 and 6.[2] The numbers of workers we use are $\overline{L}_{1l} = 60,000$, $\overline{L}_{1h} = 50,000$ and $\overline{L}_2 = 90,000$. Furthermore, we assume $s = 0.3$ and $\beta = 0.7$. For these parameter values we obtain $w_{1l}^{min} = 1.05$ and $w_{1l}^{max} = 10.00$. Depending on τ_{t-1}^{PEV1} we obtain different utility structures.

Table 5.1: Examples for Propositions 5 and 6

	τ_{t-1}^{PEV1}	$w_{1l,t}^{PEV1,min_{1h}}$	$\tilde{w}_{1l,t}^{crit,1h}$	$w_{1l,t}^{PEV1,min_{1l}}$	$\tilde{w}_{1l,t}^{crit,1l}$
1	0.1	3.18	9.02	1.32	1.70
2	0.5	2.33	5.00	0.61	0.38
3	2.5	1.00	0.95	0.09	0.02

In example 1, for both the utility functions of sector 1 high-skilled workers and sector 1 low-skilled workers, the utility minimizers 3.18 and 1.32, respectively, are larger than $w_{1l}^{min} = 1.05$. Thus, both cases can be represented by Figure 5.3. Their critical values $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu}) = 9.02$ and $\tilde{w}_{1l,t}^{crit,1l}(\tau_{t-1}^{PEV1}, \bar{\nu}) = 1.70$ exceed w_{1l}^{min}. If $\bar{w}_{1l} < 1.70$, both sector 1 voter groups will prefer the market-clearing wage, which in this case obtains as a short-run equilibrium. If $1.70 \leq \bar{w}_{1l} < 9.02$, the low-skilled workers will prefer $\bar{w}_{1l}$ but the high-skilled workers will still vote for w_{1l}^{min}. Since sector 2 workers also prefer the market-clearing outcome, it will prevail as Condorcet winner. Only if $\bar{w}_{1l} \geq 9.02$ will all sector 1 workers choose $\bar{w}_{1l}$ and the crisis outcome obtains.

In the second example, the utility functions of the high-skilled workers in sector 1 can still be represented by Figure 5.3. However, the utility functions of the low-skilled workers are represented by Figure 5.4 because the utilities' minimizer is smaller than the market-clearing wage and accordingly the critical wage level $\tilde{w}_{1l,t}^{crit,1l}(\tau_{t-1}^{PEV1}, \bar{\nu})$ is also smaller. Hence, the low-skilled will vote for any minimum wage exceeding w_{1l}^{min}. Nevertheless, as long as $\bar{w}_{1l} < \tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu}) = 5.00$, w_{1l}^{min} is the Condorcet winner. Otherwise, $\bar{w}_{1l}$ is also the preferred wage for the high-skilled workers and the crisis outcome obtains.

In example 3, both utility functions can be represented by Figure 5.4. The crisis outcome will obtain for any $\bar{w}_{1l}$.

5.2.3 Long-Run Political Equilibria

Stability Issues In period zero, voters in sector 1 obtain their critical wage levels $\tilde{w}_{1l,0}^{crit,1h}(\tau_r, \bar{\nu})$ and $\tilde{w}_{1l,0}^{crit,1l}(\tau_r, \bar{\nu})$ depending on the initial tax rate τ_r (i.e., the tax rate

[2]For the calculations we used the MAPLE software package.

that actually satisfies the state's budget constraint before period zero starts). Then, the maximum value $\bar{w}_{1l}$ for the minimum wage determines the Condorcet winner in period zero. The Condorcet winner is $\bar{w}_{1l}$ if $\bar{w}_{1l}$ is at least as large as the larger of the two both critical wage levels. If it is smaller, the Condorcet winner is w_{1l}^{min}. Therefore, the tax rate on which voters base their decisions in period 1 is either $\tau_0^{PEV1} = 0$ if $\hat{w}_{1l,0}^{PEV1} = w_{1l}^{min}$ or $\tau_0^{PEV1} = \tau_{\bar{w}_{1l}}$ if $\hat{w}_{1l,0}^{PEV1} = \bar{w}_{1l}$, where $\tau_{\bar{w}_{1l}}$ denotes the equilibrium tax rate if $\bar{w}_{1l}$ is set as minimum wage. Depending on τ_0^{PEV1}, $\tilde{w}_{1l,1}^{crit,1h}(\tau_0^{PEV1}, \bar{\nu})$ and $\tilde{w}_{1l,1}^{crit,1l}(\tau_0^{PEV1}, \bar{\nu})$ may have changed compared to period zero and thus the Condorcet winner in period 1 may have changed, too. In the following, we discuss the stability of this process, i.e., whether a long-run political equilibrium exists or not.

For the critical wage levels of the high-skilled workers of sector 1, we obtain the following lemma (for proof see appendix).

Lemma 10
The critical wage level $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$ with $\tilde{w}_{1l,t}^{crit,1h}(\frac{1-s}{s}, \bar{\nu}) = w_{1l}^{min}$ is a continuous function in τ_{t-1}^{PEV1} for $\tau_{t-1}^{PEV1} \geq 0$ and decreases strictly in τ_{t-1}^{PEV1} for $\tau_{t-1}^{PEV1} \neq \frac{1-s}{s}$.

From this we obtain the following corollary:

Corollary 1

(i) If $\bar{w}_{1l}$ and $\tau_{t-1}^{PEV1} > 0$ such that $\bar{w}_{1l} < \tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$, then $\bar{w}_{1l} < \tilde{w}_{1l,t}^{crit,1h}(0, \bar{\nu})$.

(ii) If $\bar{w}_{1l}$ and $\tau_{t-1}^{PEV1} < \tau_{\bar{w}_{1l}}$ such that $\bar{w}_{1l} \geq \tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$, then $\bar{w}_{1l} > \tilde{w}_{1l,t}^{crit,1h}(\tau_{\bar{w}_{1l}}, \bar{\nu})$.

Corollary 1 implies that the high-skilled workers of sector 1 will hold on to their original choice in the subsequent period if their original choice was the Condorcet winner. If they vote for w_{1l}^{min} and w_{1l}^{min} is set, which results in $\tau_{t-1}^{PEV1} = 0$, they will vote again for w_{1l}^{min} in the subsequent period. If they vote on the basis of τ_{t-1}^{PEV1} for $\bar{w}_{1l}$ and $\bar{w}_{1l}$ becomes the Condorcet winner in that period, $\tau_{\bar{w}_{1l}}$ is realized as an equilibrium tax rate. Then, in the next period, they will vote for $\bar{w}_{1l}$ again.

Note that τ_{t-1}^{PEV1} cannot exceed $\tau_{\bar{w}_{1l}}$ because if it did, the corresponding minimum wage $\hat{w}_{1l,t-1}^{PEV1}$ would have to be larger than $\bar{w}_{1l}$ as the equilibrium tax rate $\tau(w_{1l})$ strictly increases in w_{1l} (see equation (3.20)). But a minimum wage $\hat{w}_{1l,t-1}^{PEV1} > \bar{w}_{1l}$ is ruled out by the constitutional court.

With Lemma 10 we obtain the following proposition (for proof see appendix), which describes the long-run behavior of the economy.

Proposition 7

(i) If $\bar{w}_{1l} < \tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$, the market-clearing wage w_{1l}^{min} is the Condorcet winner in each period from t on. Hence, the market-clearing wage w_{1l}^{min} obtains as long-run political equilibrium.

(ii) If we define

$$\mathcal{M}^{nh} := \{\nu \quad | \quad \tilde{w}_{1l,t}^{crit,1l}(\nu) > \tilde{w}_{1l,t}^{crit,1h}(\nu) \quad \wedge \quad \tilde{w}_{1l,t}^{crit,1l}(\nu) > w_{1l}^{min}\}$$
and
$$\mathcal{M}^{h} := \mathcal{M} \setminus \mathcal{M}^{nh}$$

the following holds:

If $\bar{w}_{1l} \geq \tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$,$(\tau_{t-1}^{PEV1}, \bar{\nu}) \in \mathcal{M}^h$, and $(\tau_{\bar{w}_{1l}}, \bar{\nu}) \in \mathcal{M}^h$, then $\bar{w}_{1l}$ is the Condorcet winner in each period from t on. Hence, the crisis outcome $\bar{w}_{1l}$ obtains as long-run political equilibrium.

Proposition 7 (i) tells us that if the initial tax rate τ_r and $\bar{w}_{1l}$ are such that $\bar{w}_{1l} < \tilde{w}_{1l,t}^{crit,1h}(\tau_r, \bar{\nu})$, then the market-clearing outcome obtains in all periods. From Proposition 5 (i) we know that this can be the case for $\tau_r < \frac{1-s}{s}$.

We illustrate the stability of the crisis outcome according to Proposition 7 (ii) with an example:

Suppose that $(\tau_r, \bar{\nu}) = (\tau_r, s, \beta, \overline{L}_{1l}, \overline{L}_{1h}, \overline{L}_2) = (0.1, 0.3, 0.7, 60000, 50000, 90000)$. This parameter vector corresponds to the example of the last section with the initial tax rate 0.1 as τ_{t-1}^{PEV1}. We know that in this case $w_{1l}^{min} = 1.05$ and $w_{1l}^{max} = 10.00$. Furthermore, $\tilde{w}_{1l,0}^{crit,1h}(\tau_r, \bar{\nu}) = 9.02$ and $\tilde{w}_{1l,0}^{crit,1l}(\tau_r, \bar{\nu}) = 1.70$ and thus $(\tau_r, \bar{\nu}) \in \mathcal{M}^h$. Suppose the constitutional court announces that the maximum value for the minimum wage is $\bar{w}_{1l} = 9.5$. Then the Condorcet winner in period zero is $\hat{w}_{1l,0}^{PEV1} = \bar{w}_{1l} = 9.5$. If we insert this value in equation (3.20), we obtain the corresponding equilibrium tax rate as $\tau_{\bar{w}_{1l}} = 16.9$. For $(\tau_{\bar{w}_{1l}}, \bar{\nu}) = (16.9, \bar{\nu})$ we obtain $\tilde{w}_{1l,1}^{crit,1h}(\tau_{\bar{w}_{1l}}, \bar{\nu}) = 0.031$ and $\tilde{w}_{1l,1}^{crit,1l}(\tau_{\bar{w}_{1l}}, \bar{\nu}) = 0.00041$ and therefore $(\tau_{\bar{w}_{1l}}, \bar{\nu}) \in \mathcal{M}^h$. The maximum wage level $\bar{w}_{1l}$ is also the Condorcet winner in period 1, which obtains in all following periods since $\nu = (\tau_{\bar{w}_{1l}}, \bar{\nu})$ does not change any more.

In extensive simulations we were unable to find parameter vectors in $\mathcal{M}^{nh}$.[3] Therefore, we can state the following conjecture:

Conjecture 1 (Long-Run Political Equilibria under PEV1)
The $\mathcal{M}^{nh}$ set is empty.

If so, the long-run equilibrium of the political process is already reached in period zero and depends upon the critical wage level of the high-skilled workers in sector 1:

If $\bar{w}_{1l} < \tilde{w}_{1l,t}^{crit,1h}(\tau_r, \bar{\nu})$, then $\hat{w}_{1l}^{PEV1*} = w_{1l}^{min}$ and

If $\bar{w}_{1l} \geq \tilde{w}_{1l,t}^{crit,1h}(\tau_r, \bar{\nu})$, then $\hat{w}_{1l}^{PEV1*} = \bar{w}_{1l}$,

[3]Even if $\mathcal{M}^{nh}$ is not empty, the range of parameter constellations in $\mathcal{M}^{nh}$ will be small.

where $\tau_r < \infty$ is the tax rate that actually satisfies the state's budget constraint before period zero starts.

These results follow immediately from Proposition 7, since all $\nu \in \mathcal{M}^h$.

On the other hand, if $\mathcal{M}^{nh}$ is not empty other outcomes could be possible, notably cycles.

For example, suppose that $\bar{w}_{1l} \geq \tilde{w}_{1l,0}^{crit,1h}(\tau_r, \bar{\nu})$ and $(\tau_r, \bar{\nu}) \in \mathcal{M}^h$. Then, $\hat{w}_{1l,0}^{PEV1} = \bar{w}_{1l}$ and $\tau_0^{PEV1} = \tau_{\bar{w}_{1l}}$. But if $(\tau_{\bar{w}_{1l}}, \bar{\nu}) \in \mathcal{M}^{nh}$, we cannot exclude the following situation: $\tilde{w}_{1l,1}^{crit,1h}(\tau_{\bar{w}_{1l}}, \bar{\nu}) < \bar{w}_{1l} < \tilde{w}_{1l,1}^{crit,1l}(\tau_{\bar{w}_{1l}}, \bar{\nu})$. In this case, the Condorcet winner in period 1 is $\hat{w}_{1l,1}^{PEV1} = w_{1l}^{min}$. Hence, in period 2 voters base their decision on $\tau_1^{PEV1} = 0$ and we cannot exclude a constellation where $\bar{w}_{1l} \geq \tilde{w}_{1l,2}^{crit,1h}(0, \bar{\nu})$ and $\bar{w}_{1l} \geq \tilde{w}_{1l,2}^{crit,1l}(0, \bar{\nu})$. In this case, we have $\hat{w}_{1l,2}^{PEV1} = \bar{w}_{1l}$ and $\tau_2^{PEV1} = \tau_{\bar{w}_{1l}}$. This is the same situation as at the end of period zero and the process repeats infinitely, i.e., $\hat{w}_{1l,3}^{PEV1} = w_{1l}^{min}$, $\hat{w}_{1l,4}^{PEV1} = \bar{w}_{1l}$, $\hat{w}_{1l,5}^{PEV1} = w_{1l}^{min}$, $\hat{w}_{1l,6}^{PEV1} = \bar{w}_{1l}$, $\hat{w}_{1l,7}^{PEV1} = w_{1l}^{min}$, ...

Adjustment in Crises In the following, we analyze two scenarios in which crises occur. In each scenario, we compare the crisis outcome with the free-market outcome. We use the real income of voter groups as the measure of comparison. The results are summarized in Table 5.2.

We analyze an economy with $(\beta, \overline{L}_{1l}, \overline{L}_{1h}, \overline{L}_2) = (0.7, 60000, 50000, 90000)$. In scenario 1, unemployment benefits are 30% of the minimum wage for the low-skilled workers in sector 1, i.e. $s = 0.3$. In scenario 2, we assume much higher unemployment benefits with $s = 0.65$. The constitutional court announces a maximum wage level $\bar{w}_{1l}$ for the low-skilled workers guaranteeing a minimum real income of at least 0.09 for each voter group.

We obtain real income by dividing the net nominal wage by the consumer price index $\sqrt{p_1}$. This guarantees that consumers with the same real income can realize the same utility level. In the case of a Cobb-Douglas utility function $u = c_1^\alpha \cdot c_2^\beta$ with $\alpha + \beta = 1$, we can interpret the value of the real income, say 0.09, in the following way: The utility level corresponding to a real income of 0.09 is reached by assigning $\alpha \cdot 0.09$ units of good 1 and $\beta \cdot 0.09$ units of good 2 to the consumer. In our case, a real income of 0.09 corresponds to the utility level the consumer can reach with 0.045 units of good 1 and 0.045 units of good 2.

In scenario 1, if the initial tax rate τ_r is zero, i.e. the market-clearing wage w_{1l}^{min} for the low-skilled workers in sector 1 obtains and there is no unemployment, the critical wage level for the high-skilled workers of sector 1 is $\tilde{w}_{1l,t}^{cit,1h} = 10.79$. Since $\bar{w}_{1l} = 5.53$, the market-clearing wage w_{1l}^{min} obtains as long-run political equilibrium.

Table 5.2: Adjustment in Crises

	Scenario 1 $s = 0.3$, $\bar{w}_{1l} = 5.53$ $w_{1l}^{min} = 1.05$, $w_{1l}^{max} = 10.00$		**Scenario 2** $s = 0.65$, $\bar{w}_{1l} = 3.11$ $w_{1l}^{min} = 1.05$, $w_{1l}^{max} = 4.62$	
	$\tilde{w}_{1l,t}^{crit,1h}$	$\tilde{w}_{1l,t}^{crit,1l}$	$\tilde{w}_{1l,t}^{crit,1h}$	$\tilde{w}_{1l,t}^{crit,1l}$
$\tau_r = 0.00$	10.79	3.08	2.46	0.28
$\tau_r = 0.50$	5.00	0.38	1.10	0.07
$\tau_{\bar{w}_{1l}} = 1.00$	2.87	0.13		
$\tau_{\bar{w}_{1l}} = 1.37$			0.44	0.02
Voter Group	*Real Income with* $\hat{w}_{1l}^{PEV1*} = \bar{w}_{1l}$ $\frac{\Delta}{\bar{L}_{1l}} = 0.91$ $p_1 = 8.24$	$\hat{w}_{1l}^{PEV1*} = w_{1l}^{min}$ $\frac{\Delta}{\bar{L}_{1l}} = 0.00$ $p_1 = 1.58$	*Real Income with* $\hat{w}_{1l}^{PEV1*} = \bar{w}_{1l}$ $\frac{\Delta}{\bar{L}_{1l}} = 0.86$ $p_1 = 6.20$	$\hat{w}_{1l}^{PEV1*} = w_{1l}^{min}$ $\frac{\Delta}{\bar{L}_{1l}} = 0.00$ $p_1 = 1.58$
employed low-skilled	1.93	0.83	1.25	0.83
unemployed low-skilled	0.58		0.81	
low-skilled expected	0.71	0.83	0.87	0.83
high-skilled	0.09	0.43	0.09	0.43
sector 2	0.17	0.79	0.17	0.79

The constitutional court has set $\bar{w}_{1l} = 5.53$ as the highest minimum wage because a slightly higher wage level would reduce at least the high-skilled workers' real income to below 0.09.

On the other hand, an initial tax rate of 0.5 generates a critical wage level below 5.53 for the high-skilled and the low-skilled workers in sector 1. In this case, $\bar{w}_{1l} = 5.53$ is set as minimum wage and generates a tax rate $\tau_{\bar{w}_{1l}} = 1.00$. Again, 5.53 exceeds both critical wage levels and we have $\hat{w}_{1l}^{PEV1*} = 5.53$ as long-run equilibrium. Under the assumption that voters are not willing to accept a tax rate that reduces their gross wages by fifty per cent or more, i.e. $\tau_{\bar{w}_{1l}} \geq 1.00$, a political crisis would occur. If the political system adjusts to the crisis by reducing the minimum wage to w_{1l}^{min} or abolishes wage regulations, all voter groups except the employed low-skilled workers are better off. The real income of the unemployed low-skilled workers rises from 0.58 to 0.83, the real income of the high-skilled workers from 0.09 to 0.43, and the real income from workers in sector 2 from 0.17 to 0.79. Only the employed low-skilled workers do not benefit from a policy change as their real income falls from 1.93 to 0.83. But this group of workers is relatively small because only 9 per cent of all low-skilled workers are employed under $\hat{w}_{1l}^{PEV1*} = 5.53$. They lose "only" about one half of their relatively high real income, whereas the high-skilled workers' and sector 2 workers' real incomes rise by about four times the incomes they earn with $\bar{w}_{1l}$ as minimum wage. In this sense, a policy change generated by a crisis would lead to more "distributional fairness" and would reduce unemployment from 91 per cent to zero per cent. Furthermore, from an ex-ante standpoint (workers do not know whether they belong to the employed or the unemployed) all low-skilled workers would prefer the market-clearing wage because their expected real income would rise from 0.71 to 0.83.

In scenario 2, a higher share s from the minimum wage is granted in the form of unemployment benefits. The minimum wage $\bar{w}_{1l}$ generating the critical real income of 0.09 for at least one voter group is now 3.11. For this minimum wage, with Lemma 10 and Conjecture 1, $\hat{w}_{1l}^{PEV1*} = \bar{w}_{1l}$ for all initial tax rates, as 3.11 already exceeds $\tilde{w}_{1l}^{crit,1h}$ for $\tau_r = 0$. Since $\tau_{\bar{w}_{1l}} = 1.37$ exceeds 1.00, scenario 2 would also generate a political crisis. Again, all voter groups except the employed low-skilled workers benefit from a policy change to market-clearing minimum wages. Under scenario 2, the employed low-skilled workers lose less than under scenario 1 because the long-run outcome $\hat{w}_{1l}^{PEV1*} = \bar{w}_{1l}$ is smaller under scenario 2. The gain of the unemployed low-skilled is relatively small, whereas the high-skilled workers and workers in sector 2 stand to gain as much as under scenario 1.[4] Furthermore, the low-skilled workers as a whole lose, because their expected real income is somewhat higher with $\hat{w}_{1l}^{PEV1*} = \bar{w}_{1l}$ than with $\hat{w}_{1l}^{PEV1*} = w_{1l}^{min}$. Nevertheless, under scenario 2 we also have more distributional fairness by a policy change from high minimum wages to market-clearing wages.

From the discussion of the actual utility functions, i.e. the perceived utility functions under GEV, we know that under the given tax regime the high-skilled workers of sector 1 and the workers of sector 2 always gain from lower minimum wages for the low-skilled workers. Furthermore, any minimum wage decrease is pareto-superior and w_{1l}^{min} is pareto-optimal because the lower the minimum wage, the higher is total output. The gains in total output could be distributed in such a way that any voter group is better off compared to $\bar{w}_{1l}$.

5.3 Interpretation of Results

Under PEV1 voters look at the first goods market:

$$\tilde{L}_{1l,t}^{PEV1} \frac{\tilde{b}_{1l,t}^{PEV1}}{2\tilde{p}_{1,t}^{PEV1}} + \tilde{L}_{1h,t}^{PEV1} \frac{\tilde{b}_{1h,t}^{PEV1}}{2\tilde{p}_{1,t}^{PEV1}} + \tilde{L}_{2,t}^{PEV1} \frac{\tilde{b}_{2,t}^{PEV1}}{2\tilde{p}_{1,t}^{PEV1}} + \tilde{\Delta}_t^{PEV1} \frac{\tilde{b}_{un,t}^{PEV1}}{2\tilde{p}_{1,t}^{PEV1}} = \tilde{q}_{1,t}^{PEV1}$$

If we take into account the fact that the labor markets for the high-skilled workers of sector 1 and the workers of sector 2 always clear this is equivalent to the following

[4] The change in real income for workers in sector 2 is very small. It is still about 0.17 in scenario 2.

equation:

$$\Big((1-s)\tilde{L}_{1l,t}^{PEV1} + s\overline{L}_{1l}\Big)\frac{w_{1l,t}}{\tilde{p}_{1,t}^{PEV1}} + \overline{L}_{1h}\frac{\tilde{w}_{1h,t}^{PEV1}}{\tilde{p}_{1,t}^{PEV1}} + \overline{L}_2\frac{\tilde{w}_{2,t}^{PEV1}}{\tilde{p}_{1,t}^{PEV1}} = 2\tilde{q}_{1,t}^{PEV1} \tag{5.9}$$

From equation (5.9) voters can draw the following qualitative conclusions:

Note first that not much can be said for small changes in $w_{1l,t}$. Suppose that $\tilde{p}_{1,t}^{PEV1}$ remains constant while $w_{1l,t}$ increases. Then we would have two opposite effects on the aggregate demand of all low-skilled workers. On the one hand, relative labor costs (see Definition 2, p. 50) of the low-skilled workers $\Big(w_{1l,t}(1+\tilde{\tau}_t^{PEV1})\Big)/\tilde{p}_{1,t}^{PEV1}$ would increase and therefore $\tilde{L}_{1l,t}^{PEV1}$ would decrease since firms' demand for low-skilled labor would decrease. On the other hand, real income for each low-skilled worker who would not lose his job would increase. We do not know the net effect on aggregate demand of the low-skilled workers without explicitly computing the results for a small change in minimum wages. Furthermore, aggregate demand of high-skilled workers for good 1 would decrease. The reason is that high-skilled labor and low-skilled labor are complementary inputs and thus - to guarantee clearance of the high-skilled labor market - relative labor costs for the high-skilled workers $\Big(\tilde{w}_{1h,t}^{PEV1}(1+\tilde{\tau}_t^{PEV1})\Big)/\tilde{p}_{1,t}^{PEV1}$ have to decrease when the level of low-skilled labor force goes down. [5] Aggregate demand of workers in sector 2 for good 1 would remain constant while output in sector 1 would decrease because $\tilde{L}_{1l,t}^{PEV1}$ would have decreased. Qualitatively, it is not clear how $\tilde{p}_{1,t}^{PEV1}$ would have to change to equalize both sides of equation (5.9). A decreasing $\tilde{p}_{1,t}^{PEV1}$ would further increase the relative labor costs of the low-skilled workers. Therefore, output in sector 1 would decrease even more as would the aggregate demand of high-skilled workers for good 1. But the effect on the aggregate demand of the low-skilled workers is unclear whereas aggregate demand of workers in sector 2 would increase. An increasing $\tilde{p}_{1,t}^{PEV1}$ would lead to opposite effects. Both scenarios are conceivable, as long as the quantitative changes are not analyzed.

But for large changes in $w_{1l,t}$ we can draw some conclusions. Suppose that $w_{1l,t}$ increased starting from w_{1l}^{min}. Then, upward at least of some level of $w_{1l,t}$, the price for good 1, $\tilde{p}_{1,t}^{PEV1}$ would have to increase relative to its initial level because otherwise equation (5.9) would not hold. With constant or decreasing $\tilde{p}_{1,t}^{PEV1}$ relative labor costs of the low-skilled workers of sector 1, $\Big(w_{1l,t}(1+\tilde{\tau}_t^{PEV1})\Big)/\tilde{p}_{1,t}^{PEV1}$ would increase and thus $\tilde{L}_{1l,t}^{PEV1}$ would converge to zero. Hence, the output of good 1 would also converge to zero. But the aggregate demand of the low-skilled workers would increase although almost all of them would become unemployed. Hence, the left-hand side of equation

[5] If we know that $\Big(\tilde{w}_{1h,t}^{PEV1}(1+\tilde{\tau}_t^{PEV1})\Big)/\tilde{p}_{1,t}^{PEV1}$ has to decrease, we know that $\tilde{w}_{1h,t}^{PEV1}/\tilde{p}_{1,t}^{PEV1}$ will decrease because $\tilde{\tau}_t^{PEV1}$ equals τ_{t-1}^{PEV1} , i.e. it is supposed to remain constant.

(5.9) would increase more and more, while the right-hand side would converge to zero. Therefore, upward of a certain level of $w_{1l,t}$, $\tilde{p}_{1,t}^{PEV1}$ would have to increase to guarantee market-clearing for good 1. The argument implies that there would have to be an upper bound for $\Big(w_{1l,t}(1+\tilde{\tau}_t^{PEV1})\Big)/\tilde{p}_{1,t}^{PEV1}$.

Now we can discuss the utility levels of voters for high values of $w_{1l,t}$. Since there would be an upper bound for relative labor costs of the low-skilled workers, the level of the low-skilled work force could not fall below a certain value. Hence, there would be a lower bound greater than zero for the relative labor costs of the high-skilled workers, i.e. $\Big(\tilde{w}_{1h,t}^{PEV1}(1+\tilde{\tau}_t^{PEV1})\Big)/\tilde{p}_{1,t}^{PEV1}$ could not fall below a certain level because of the complementarity of labor inputs in sector 1 and market-clearing in the high-skilled workers' labor market. Furthermore, we know that $\tilde{p}_{1,t}^{PEV1}$ would have to increase if $w_{1l,t}$ increased at least upward of a certain value of $w_{1l,t}$. Since relative labor costs for the high-skilled workers would have a lower bound greater than zero, an infinitely increasing $\tilde{p}_{1,t}^{PEV1}$ would mean that $\tilde{w}_{1h,t}^{PEV1}$ also increases infinitely. Thus aggregate demand of the high-skilled workers in sector 1 for good 2 would rise infinitely if $\tilde{w}_{1h,t}^{PEV1}$ went to infinity, since the nominal price level $\tilde{p}_{2,t}^{PEV1}$ is supposed to remain constant at 1. [6] The crucial point here is that voters ignore the second goods market. Therefore, they assume that each demand level in this market, $\tilde{L}_{i,t}^{PEV1} \cdot (\tilde{b}_{i,t}^{PEV1}/2)$ with $i = 1l$, $1h$, 2, un, can be satisfied. Hence, the high-skilled workers of sector 1 would perceive an infinite utility level for infinite levels of $w_{1l,t}$, since the lower bound of $\Big(\tilde{w}_{1h,t}^{PEV1}(1+\tilde{\tau}_t^{PEV1})\Big)/\tilde{p}_{1,t}^{PEV1}$ would guarantee a finite level of aggregate consumption for good 1, while aggregate demand of high-skilled workers for good 2 could be satisfied infinitely.

Note that this would not have to be the case if voters took into account general equilibrium feedbacks in the way they perceived an increasing tax rate. Then, there could be a lower bound greater than zero for $\Big(\tilde{w}_{1h,t}^{PEV1}(1+\tilde{\tau}_t^{PEV1})\Big)/\tilde{p}_{1,t}^{PEV1}$ with a decreasing nominal wage $\tilde{w}_{1h,t}^{PEV1}$. Hence, if $\Big(\tilde{w}_{1h,t}^{PEV1}(1+\tilde{\tau}_t^{PEV1})\Big)/\tilde{p}_{1,t}^{PEV1}$ converged to a lower bound utility of high-skilled workers would fall and not rise.

Since the wages of workers in sector 2 $\tilde{w}_{2,t}^{PEV1}$ are supposed to remain constant and the price of good 1 would rise infinitely, their perceived aggregate consumption for good 1 would converge to zero, while their aggregate consumption for good 2 would not change. Hence - according to the relevant Cobb-Douglas utility function - their utility level would converge to zero.

From equation (5.9) and considerations with relative labor costs, we cannot draw conclusions for relative labor costs of the low-skilled work force for high values of $w_{1l,t}$. We cannot exclude a situation where $\Big(w_{1l,t}(1+\tilde{\tau}_t^{PEV1})\Big)/\tilde{p}_{1,t}^{PEV1}$ converges to zero when

[6] Voters "normalize" the price of good 2 to 1.

$w_{1l,t}$ approaches infinity. If the relative labor costs of the low-skilled work force did, we would have a trade-off between infinitely small values of $w_{1l,t}/\tilde{p}_{1,t}^{PEV1}$ and infinitely high values for $\tilde{L}_{1l,t}^{PEV1}$. It is not clear in this case whether aggregate demand of the low-skilled workers for good 1 would decrease or increase in $w_{1l,t}$. If it decreased, the perceived consumption of good 1 for one low-skilled worker would converge to zero, but on the other hand, the perceived consumption of good 2 would approach infinity. The resulting effect on utility would be unclear.

But if voters assumed that relative labor costs would not fall below the value where all $\overline{L}_{1l}$ low-skilled workers were employed because it is not possible to employ more low-skilled workers than actually exist, they would perceive that the low-skilled utility level would approach infinity if $w_{1l,t}$ approaches infinity. The consumption of good 1 by all low-skilled workers would be finite because production of good 1 would be finite and their consumption of good 2 would approach infinity.

Note that the assumption of a lower bound for the real wages of the low-skilled workers - i.e. their relative labor costs cannot fall below the market-clearing level - helps to explain the perceived economic outcomes, although it is not explicitly given under PEV1. Nevertheless, it does not contradict the assumptions made under PEV1, i.e. constancy of sector-2 variables, constancy of the tax rate and market-clearing in the first goods market.

We have shown that the perceived utility levels of the high-skilled and low-skilled workers of sector 1 would approach infinity if $w_{1l,t}$ approached infinity. But we also know that both utility functions would have exactly one minimizer, which means that for low levels of $w_{1l,t}$ the utility levels would decrease in $w_{1l,t}$. If we take into account the analytical results, the reason for this behavior could be that perceived employment would be supposed to decrease if minimum wages increased (see equation 5.5). With decreasing employment of low-skilled workers in sector 1, output in sector 1 decreases. Hence, aggregate consumption of all voter groups has to decrease, too. Consequently, we could have a negative effect on all utility levels from rising unemployment. Notably, low-skilled workers who lose their jobs receive less money. Furthermore, a decrease in the low-skilled labor force has a negative effect on labor demand for high-skilled workers and thus a negative effect on their nominal wage. But if minimum wages increased further, these negative effects would be balanced out at some point by increasing nominal wage levels $w_{1l,t}$ and $\tilde{w}_{1h,t}^{PEV1}$. They generate increasing perceived demand levels in goods market 2 which are assumed to be satisfied. On the other hand - as shown above - perceived aggregate demand of high-skilled and low-skilled workers in goods market 1 could not fall below some finite level and thus utility levels would rise infinitely.

This argument can also help to explain Conjecture 1 (Long-Run Political Equilibria under PEV1). The critical wage level of the low-skilled workers could be smaller than that of the high-skilled workers because the negative effects of decreasing employment on the utility functions of low-skilled workers are reduced by unemployment benefits. Therefore, smaller values of $w_{1l,t}$ than those for the high-skilled workers may suffice to balance out the negative effect of decreasing employment on the perceived consumption of good 1.

Intuitively, the argument with negative effects caused by decreasing employment could also explain the falling critical wage level of high-skilled workers $\tilde{w}_{1l,t}^{crit,1h}$ for increasing tax rates τ_{t-1}^{PEV1}: The higher the initial tax rate in a given period, the higher initial unemployment will be. Thus, additional unemployment could not cause much additional "damage" to the high-skilled workers' utility levels. The negative effects would have been balanced out for relatively low levels of $w_{1l,t}$ if initial unemployment had already been relatively high.

Chapter 6

Discussion and Conclusions

6.1 Robustness

We have seen that under each misleading view - PEV and PEV1 - two groups of voters always prefer a minimum wage that exceeds the market-clearing wage. Depending on w_{1l}^{max} and constitutional rules, this can lead to political outcomes which do not correspond to the free-market outcome and hence are not efficient. The question arises whether this result - i.e., the political process can lead to inefficient economic outcomes - is also achieved from other views.

In the following we look at three additional views. Views 1 and 2 correspond to PEV and PEV1 respectively but voters assume that the nominal price level in the first sector does not change while $\tilde{p}_{2,t}$ varies in $w_{1l,t}$. Under View 3, voters assume that the relative price of good 1 and 2 does not change.

We discuss our considerations for the same parameter values as in the preceding sections for GEV, PEV and PEV1: $s = 0.75$, $\beta = 0.4$, $\overline{L}_{1l} = 70,000$, $\overline{L}_{1h} = 50,000$, $\overline{L}_2 = 100,000$ and $\tau_{t-1} = 0$.

Under View 1 and 2, voters "normalize" the price for good 1, $\tilde{p}_{1,t} = 1$, and let $\tilde{p}_{2,t}$ change with the minimum wage. In this case, perceived profits in the second sector no longer have to be zero because they are given by:

$$\begin{aligned}
\tilde{\pi}_{2,t} &= \tilde{p}_{2,t}\tilde{q}_{2,t} - \tilde{w}_{2,t}(1+\tilde{\tau}_t)\tilde{L}_{2,t} \\
&= \tilde{p}_{2,t}\overline{L}_2 - \frac{1}{1+\tau_{t-1}}(1+\tau_{t-1})\overline{L}_2 \\
&= \tilde{p}_{2,t}\overline{L}_2 - \overline{L}_2 \qquad (6.1)
\end{aligned}$$

Clearly, if $\tilde{p}_{2,t} \neq 1$ profits would not be zero. Under PEV and PEV1, profits were always zero since voters assumed $\tilde{p}_{2,t} = 1$.

Under Views 1 and 2, perceived profits in the first sector are still zero, since firms are perceived to be able to adapt their labor demands to the corresponding first-order conditions (see equations 3.12 and 3.13) with $\tilde{p}_{1,t} = 1$.[1]

Under View 1, voters assume $\tilde{p}_{1,t} = 1$ and clear the second goods market. We observe that the utility functions of all voter groups and the price function for good 2 are U-shaped. All voters would prefer a minimum wage $w_{1l,t}$ that would be as high as possible.

The reason is the following: Upward of some level of $w_{1l,t}$, $\tilde{p}_{2,t}$ would have to increase to diminish real aggregate demand of the low-skilled workers for good 2. Otherwise their demand would be higher than $\tilde{q}_{2,t} = \overline{L}_2$. On the other hand, aggregate real demand of the high-skilled workers in sector 1 and workers in sector 2 resulting from profits would amount to $\frac{1}{2}\frac{\tilde{\pi}_{2,t}}{\tilde{p}_{2,t}} = \frac{1}{2}(\overline{L}_2 - \frac{\overline{L}_2}{\tilde{p}_{2,t}})$. Since the upper bound in real aggregate demand of high-skilled workers and workers of sector 2 would be less than $\tilde{q}_{2,t} = \overline{L}_2$ [2], real aggregate demand of all low-skilled workers for good 2 would be greater than zero. Thus real aggregate demand of each voter group for good 2 would be greater than zero. Furthermore, at least aggregate demand for good 1 for all low-skilled workers of sector 1 and workers of sector 2 would increase if $w_{1l,t}$ increased, because $w_{2,t}$ remains constant and $\frac{\tilde{\pi}_{2,t}}{\tilde{p}_{2,t}}$ would strictly increase. Hence, these groups would always prefer a higher minimum wage. Note that this only holds because voters wrongly assume that their demand for good 1 can be satisfied, which is actually not the case. Note furthermore that these considerations do not depend on parameter values.

Under View 2, we have $\tilde{p}_{1,t} = 1$ and clearance of the first goods market. For the parameter values given above, this results in a U-shaped utility function for the low-skilled workers of sector 1 and workers of sector 2. Both approach infinity for a value of $w_{1l,t}$ that is greater than w_{1l}^{min} but smaller than w_{1l}^{max}. $\tilde{U}_{1h,t}$ strictly decreases as $\tilde{p}_{2,t}$ does. The price for good 2 reaches zero for a value of $w_{1l,t}$ between w_{1l}^{min} and w_{1l}^{max}.

How can we explain this behavior? Voters look at the first goods market. An increasing $w_{1l,t}$ with constant $\tilde{\tau}_t$ and $\tilde{p}_{1,t}$ would lead to a decreasing output of good 1 and - at least upward of some level of $w_{1l,t}$ - to an increasing aggregate real demand of all low-skilled workers for good 1. Obviously, this contradictory effect concerning goods market-clearing would lead to a maximum value of $w_{1l,t}$ beyond which the economy would collapse, since the first goods market could not be cleared with positive prices. The price for good 2 would have to diminish to reduce profits and therefore the real aggregate demand of all high-skilled workers and sector 2 workers for good 1. Real aggregate demand of all low-skilled workers and workers of sector 2 for good 1 would

[1] The production technology exhibits constant returns to scale.

[2] If $w_{1l,t}$ rises, the perceived nominal wage for the high-skilled workers, $\tilde{w}_{1h,t}$, will diminish since employment of the low-skilled workers will decrease.

be positive. The latter would hold because the sector 2 workers' budget would equal $\overline{L}_2\left(\tilde{w}_{2,t} + \frac{\tilde{\pi}_{2,t}}{\overline{L}_{1h}+\overline{L}_2}\right)$ and the costs that would reduce profits for sector 2 workers as firm owners are channeled back to them as wages. Hence, as long as $\tilde{p}_{2,t} > 0$ their budget would be strictly positive. On the other hand, since $\tilde{p}_{2,t}$ would approach zero and budgets are strictly positive, perceived aggregate consumption of the low-skilled workers and sector 2 workers for good 2 would approach infinity. Thus, their utility levels would do so too. The high-skilled workers of sector 1 would lose if minimum wages increased, because profits would become negative and $\tilde{w}_{1h,t}$ would approach zero. This is because employment of the low-skilled workers would approach zero and both labor factors are complementary. Again, these considerations do not depend on parameter values.

Under View 3 voters assume that relative prices between good 1 and good 2 will remain constant, together with $\tilde{w}_{2,t}$ and $\tilde{\tau}_t$. Voters assume that all goods markets are cleared automatically and do not look at them for their considerations. For our computations we take the free-market solution for goods prices, $\tilde{p}_{1,t} = 1.58$ and $\tilde{p}_{2,t} = 1$. Then, profits would be zero and we obtain the following outcome: The utility function of the low-skilled workers is U-shaped, the utility function of the high-skilled workers strictly decreases and the utility level of sector 2 workers is constant. Sector 1 low-skilled workers would clearly gain from rising minimum wages, because prices would be constant. They prefer a minimum wage that is as high as possible. The high-skilled workers would lose, since employment of the low-skilled workers would decrease and thus the firms' demand for their labor would also decrease. Consequently, $\tilde{w}_{1h,t}$ would decrease if employment decreased with rising minimum wages. The utility of sector 2 workers would be completely unaffected, since goods prices and $\tilde{w}_{2,t}$ are perceived to remain constant.

Summing up the results we find that, in four out of five misleading views, at least two voter groups prefer a minimum wage that is as high as possible, as long as they consider the level of $w_{1l,t}$ to be economically feasible. Hence, in these cases political outcomes can occur that may lead to crises. In the case with fixed relative good prices, the outcome depends upon whether there are more low-skilled workers or high-skilled workers or what sector 2 workers will vote for in the case of indifference.

6.2 Overall Comparison

6.2.1 Economic Results

In the following, we derive some conclusions that illustrate the structure of misleading beliefs that voters entertain.

Under the assumptions of a constant tax rate, constant nominal wages for workers in sector 2 and a constant nominal price level for one good, voters consider how economic variables have to behave to secure clearance of the respective market, e.g. goods market 2 under PEV. Given the minimum wage for the low-skilled workers, they have to adapt the perceived demand functions of voter groups in the market analyzed. The crucial point is that they assume that their demand for goods in the market they do not look at is completely satisfied. But this is actually not true because their assumptions are wrong, i.e., they do not take into account all general equilibrium effects.[3] Only if voters looked at both markets could they recognize contradictory effects resulting from their assumptions and perhaps revise their views.

Under PEV, clearance of the second goods market and redistribution to the low-skilled workers would require a decreasing demand of high-skilled workers for good 2 and thus a decreasing price $\tilde{p}_{1,t}^{PEV}$ for good 1: Voters only look indirectly at the first goods market via the demand of high-skilled workers for good 2, which would have to diminish. This can only be accomplished by a decrease in $\tilde{w}_{1h,t}^{PEV}$. Consequently, $\tilde{p}_{1,t}^{PEV}$ also has to decrease, since clearance of the high-skilled labor market requires constant relative labor costs (see Definition 2, p. 50). Since the nominal wage of workers in sector 2 is assumed to remain constant, this leads to the perception of an ever-increasing utility level for workers in sector 2. As $\tilde{w}_{2,t}^{PEV}$ would remain constant while $\tilde{p}_{1,t}^{PEV}$ would converge to zero, the perceived satisfied demand for good 1 rises infinitely.

In contrast, under PEV1, voters perceive that output of good 1 decreases if minimum wages for the low-skilled workers increase. Therefore, they also perceive (correctly) a rising price level for good 1. Hence, workers in sector 2 are assumed to lose wealth if the minimum wage is increased, as their nominal wage level $\tilde{w}_{2,t}^{PEV1}$ is assumed to remain constant. But to guarantee market-clearing under the PEV1 assumptions, employment of the low-skilled workers must not converge to zero.[4] Since low-skilled and high-skilled labor are complementary inputs, high-skilled workers in sector 1 are

[3]Under GEV they take into account all general equilibrium repercussions. Hence the view of only one market is not misleading.

[4]If employment of low-skilled workers converged to zero, output would also converge to zero, while real wages of the low-skilled would approach infinity. This cannot be a market equilibrium.

perceived to have a finite consumption level of good 1 and - as $\tilde{w}_{1h,t}^{PEV1}$ would increase - an infinite consumption level for good 2.[5] Hence, under PEV1 they would gain from rising minimum wages.

Similarly, under Views 1 and 2, two voter groups perceive increasing utility levels with a rising minimum wage $w_{1l,t}$ because they assume that the demand on the markets they do not observe is satisfied. The same holds for low-skilled workers under View 3. They are the only group that is always perceived to gain from higher minimum wages (except under GEV).

A further observation is that voters perceive a maximum value for $w_{1l,t}$ beyond which the economy will collapse if they analyze the goods market for which the price is assumed to remain constant. These are PEV and View 1. The reason is that only an increasing price level could guarantee market-clearing if nominal budgets of the low-skilled workers rose with rising minimum wages. But if the price is assumed to remain constant, market-clearing will be impossible upward of some level of $w_{1l,t}$, because the low-skilled workers' real budget will exceed the output of the respective good.

6.2.2 Political Results

If we look at the political outcomes under PEV and PEV1, we find that crises can be self-increasing. The higher the last period's equilibrium tax rate, the more likely voters are to vote for higher minimum wages.

The short-run political equilibrium under PEV, $\hat{w}_{1l,t}^{PEV}$ strictly increases in the last period's tax rate $\tau_{t-1}^{PEV} = (2 - s\beta)^t(1 + \tau_r) - 1$ (see Proposition 2), which itself strictly increases in t. One possible interpretation is that with an increasing tax rate the perceived nominal wage in sector 2, $\tilde{w}_{2,t}^{PEV}$ decreases. Hence - in the perception of voters - more wealth can be redistributed to the low-skilled workers before their real demand for good 2 exceeds output in the second sector and the economy collapses. The maximum value for the minimum wage would increase and with it the value of the Condorcet winner $\hat{w}_{1l,t}^{PEV}$ in the perspective period.

Under PEV1, we observe that $\tilde{w}_{1l,t}^{crit,1h}$ falls if τ_{t-1}^{PEV} rises, i.e., the higher the last period's tax rate, the more "likely" the highest possible minimum wage $\bar{w}_{1l}$ is to exceed $\tilde{w}_{1l,t}^{crit,1h}$. Thus the inefficient outcome $\bar{w}_{1l}$ obtains. We could explain this voting behavior as a kind of fatalism. Since the last period's unemployment is already high together with high tax rates, voters cannot lose much more if unemployment increases further. They would vote for the highest possible minimum wage because benefits from more

[5] Because $\tilde{p}_{1,t}^{PEV1}$ would increase, the perceived nominal wage $\tilde{w}_{1h,t}^{PEV1}$ has to increase in order to guarantee clearance of the high-skilled workers' labor market.

redistribution to the low-skilled workers are perceived to be higher than the losses connected with higher unemployment.

6.3 Conclusions

In this part of the thesis we gave an additional explanation for the persistence of inefficient regulations and the emergence of crises in democracies. Inefficiencies in market regulations can arise because voters have incorrect views about the economy. We showed that neglecting general equilibrium repercussions from the regulated sector on the rest of the economy (i.e., the unregulated sector and the tax rate) can lead voters to set regulations that are not only detrimental to the economy as a whole (total output) but also damage their own welfare. Even if a crisis occurs, reforms that result in efficient regulations can only take place with certainty if people anticipate general equilibrium effects correctly. However, crises can induce a better recognition of general equilibrium effects which will trigger a reversal of bad times. If this argument is significant enough, the question emerges whether it is possible for democracies to adopt GEV early on and thus avoid the painful cleansing effect caused by crises. Whether institutional frameworks for democracies exist that can trigger GEV is the question we will try to answer in Part II.

Part II

Policy Reversal

Chapter 7

Model

7.1 Introduction

We have shown in Part I that neglecting general equilibrium effects can lead to inefficient political decisions concerning governmental regulations. The reason is that voters' ignorance causes them to draw wrong conclusions from the degree of regulation to outcomes.

Our main focus in the first part has been the non-awareness of general equilibrium repercussions by the decision makers which can *actually* result in inefficient outcomes. We have not focused on the political process itself. Therefore, we have simply assumed a direct translation of economic viewpoints into political outcomes: The Median-voter announces his ideal point which is immediately proposed and implemented by parties.

If we asked for institutional remedies of the crisis problem within this simple political framework we would have to solve a very difficult problem: We would have to find a way to make the voter use "rational" devices of decision-making. An economic crisis could certainly promote efforts in doing so but the reverse could also be true, i.e., because of bad economic conditions voters wouldn't have enough time and money to gather the relevant information and make complex decisions.

In the following, we will take a mental process which generates a special view as given. We assume that some views exist exogenously and the problem of an efficient decision is a political one in selecting a correct view. We will interpret the persistence of a crisis as a possible outcome of a voting game in which the existence of a misleading economic view is a necessary, but not sufficient condition for persistence: The crisis is driven by a combination of a misleading view and the specific characteristics of the decision process we will analyze. On the other hand, the reversal of a detrimental development is due to the adoption of a correct viewpoint. This view emerges in response to the observation of economic problems. Whether this view is adopted by voters is a question of the political process itself.

The crisis arises since economic conditions have changed, but economic policy is still orientated towards an economic view that has led to high output under the economic conditions of the past. Although the correct viewpoint on the present conditions exists, agents are uncertain about which theory of the economy is the appropriate one.

There is much empirical evidence for the possible persistence of a policy that has become inappropriate due to a change in economic environment. For example, Ljungqvist and Sargent (1998) explain the high European unemployment rates by an increasing "welfare state". Although economic conditions have changed rapidly from the mid 1970s on, many Western European countries have continued with their policy of rising unemployment benefits. Ljungqvist and Sargent argue that this policy together with the effects of "globalization"[1] are a main cause for the persistent rise in European unemployment after there had been low rates until the 1970s. In contrast, the United States have been much more restrictive in granting unemployment benefits, and, at the same time, have much lower unemployment rates. Another example is presented by Rodrik (1996), who observes that many countries in Latin America responded to a severe debt crisis in the 1980s by tightening already existing trade restrictions. The market-oriented reforms adequate to the changed economic environment were endorsed only after a time lag of several years.

In the following analysis, our concern will be under which conditions incorrect views prevail, as well as under which conditions and by which means they can be removed by a correct viewpoint. For this, we discuss a voting game in which the incumbent party has office concerns but also has partisan concerns. The latter concerns favor the detrimental policy of the past. Voters are not only uncertain about the correct state of the world but also about the actual economic goals of the incumbent party, i.e., whether it supports its partisans primarily, or rather the interests of the Median-voter who suffers from the crisis. Therefore and because information is costly for the incumbent party, the party's platform may not reveal the correct view, even though the party in office is able to discover this view since it has the corresponding governmental resources. Hence, information transmission from the incumbent party via its political platform is subject to a signaling game.

It results that even if the governmental party reveals its information, this may not be fully recognized by voters. Nevertheless, if the proposed platform is "credible" enough to voters, they may approve it. Thus, a policy reversal may occur without fully

[1] These effects are for example the adoption of information technologies, increasing international trade, or the restructuring from manufacturing to the service industry.

recognized information revelation or even with an uninformed party. We find two possible scenarios that can lead to a policy reversal.

Firstly, when the costs of information for the incumbent party are large relative to maximal losses of voters from a wrong policy, opportunistic behavior of the incumbent party "accidentally" induces it to propose the correct policy when the crisis is severe enough. The party has no incentive to gather information and just proposes the policy risk-averse voters approve with higher probability. This is the opposite policy to that which has been implemented so far.

Secondly, the probability of reversal is higher, the higher the probability that the governmental party informs. The incentive to inform increases when information costs are low relative to maximal voter losses of reform and when the possible reform proposals are very risky since they are very large. One intuitive result is that when the governmental party proposes a very large reform which is in opposition to its partisan interests, voters know with certainty that the party is informed and proposes the correct state of the world. In this case of information being revealed, a reversal occurs with certainty.

In the remainder of this chapter we formalize the idea of two competing viewpoints in the political sphere, where both claim to explain the economy in the correct way. Two parties run for office, each of them proposing a political platform which consists of a theory about the functioning of the economy (viewpoint) and a corresponding economic policy proposal. The outcome of this voting game determines whether a policy that supports a crisis persists or whether a policy reversal occurs. We describe the equilibrium concept and derive the equilibria of the game in Chapters 8 and 9. A discussion of the equilibria's characteristics can be found in Sections 10.1 to 10.3. Sections 10.4 to 10.6 consist of extensions of the model and a concrete analysis concerning the conditions of policy reversal. In Section 10.7, we relax some assumptions and analyze the robustness of our model. Section 10.8 concludes.

7.2 Model

7.2.1 Agents, Views and Preferences

We adapt our model from Part I. There are three voter groups, L, M and R with policy preferences which can differ from each other. Again, each voter group has less than fifty per cent of votes. Therefore, to gain a majority of votes, a proposal must be supported by at least two voter groups.

Economic conditions are related to some forms of regulation, e.g., a minimum wage.

The regulation is represented by a "regulation parameter" $w \in [0,1]$. This parameter represents the relative size of regulation. If $w = 0$ there is no regulation, e.g. the minimum wage level equals the market-clearing wage level. If $w = 1$ we have maximum regulation, e.g. the minimum wage has the highest economically feasible level. There is a direct relationship between total consumption and the parameter. Therefore, total consumption of voter groups can be represented by consumption functions $c_L(w), c_M(w)$, and $c_R(w)$, which depend on regulation w. We assume a Cobb-Douglas utility function and thus risk aversion of voters

$$U_i(c_i(w)) = \sqrt{c_i(w)} \tag{7.1}$$

where $i = L, M, R$.

Agents are ex-ante uncertain about the consequences of regulation. In the political sphere, there are two different views v - or theories - about the mapping of policies into outcomes.[2] We call them P and G (, i.e., $v \in \{P, G\}$) and assume that each of them suggests consumption functions with a linear relationship between regulation and consumption level. We denote the functions by $c_i^P(w)$ and $c_i^G(w)$. The highest consumption level for each group is $\bar{c}$ and the lowest level is $\underline{c}$, where $\bar{c} > \underline{c} > 0$. For the L-group, the relationship between regulation and consumption is strictly positive. According to both views, L-voters reach their maximal consumption level $\bar{c}$ with maximal regulation $w = 1$, i.e. $c_L^P(1) = c_L^G(1) = \bar{c}$, and their minimal consumption level with $w = 0$, i.e. $c_L^P(0) = c_L^G(0) = \underline{c}$. The opposite holds for the R-group. Both P and G suggest a strictly negative relationship between regulation and consumption. R-voters always maximize their consumption with minimal regulation, i.e. $c_R^P(0) = c_R^G(0) = \bar{c}$. Only group $M's$ ideal point depends on views P and G. According to P, voter group $M's$ highest consumption level $\bar{c}$ is reached if $w = 1$, whereas, according to G, group M would like to have no regulation at all, i.e. $w = 0$. Denoting the difference between maximum and minimum consumption as $\Delta c = \bar{c} - \underline{c}$, the described relationships can be summarized by the following equations (see also Figures 7.1 and 7.2):

$$\begin{aligned} c_L^P(w) &= \underline{c} + w\Delta c \\ c_M^P(w) &= \underline{c} + w\Delta c \\ c_R^P(w) &= \bar{c} - w\Delta c \end{aligned} \tag{7.2}$$

and

$$\begin{aligned} c_L^G(w) &= \underline{c} + w\Delta c \\ c_M^G(w) &= \bar{c} - w\Delta c \\ c_R^G(w) &= \bar{c} - w\Delta c \end{aligned} \tag{7.3}$$

Figure 7.1: Consumption of voter groups when $\theta = P$

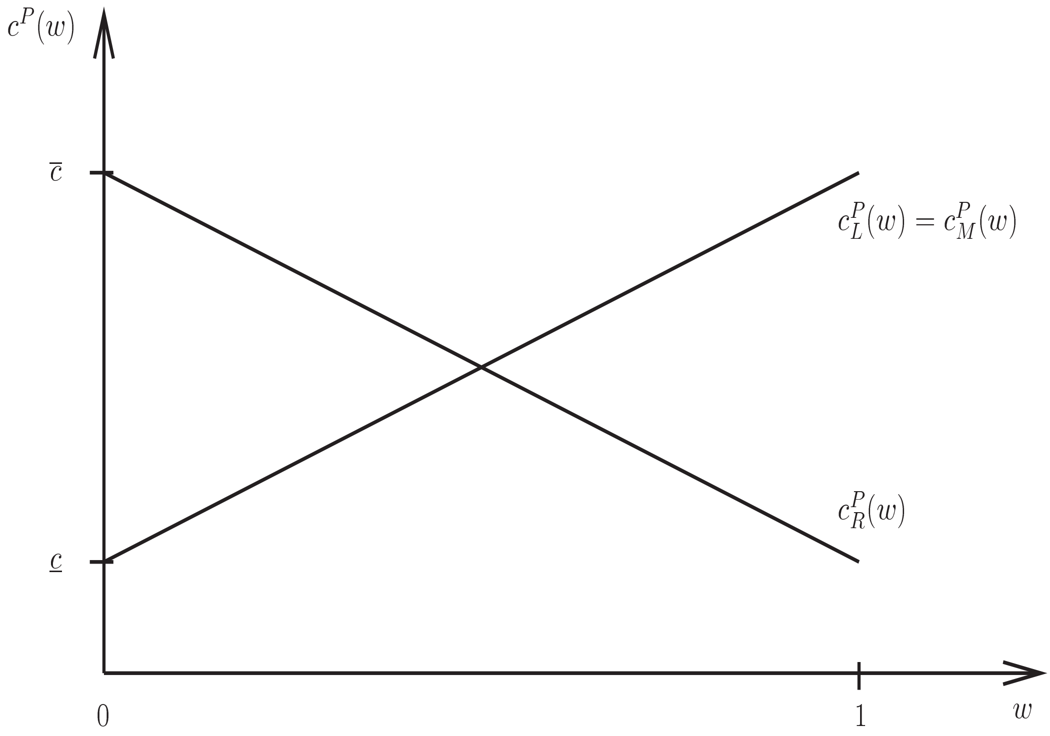
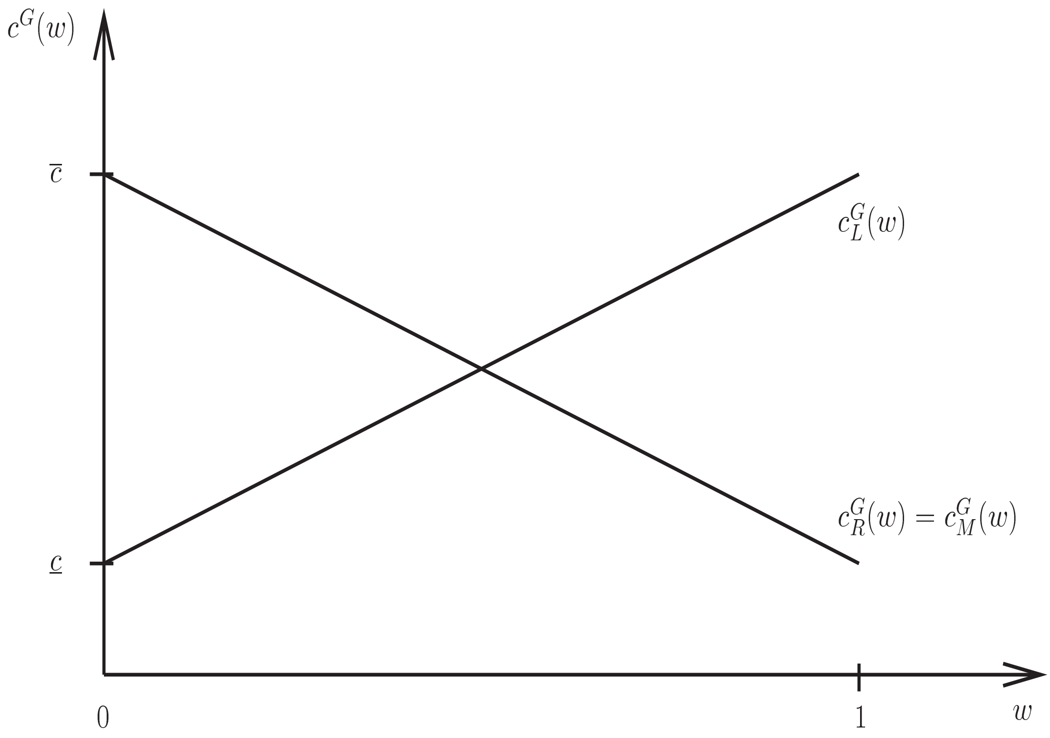


Figure 7.2: Consumption of voter groups when $\theta = G$



The public consists of voter groups L, M, R and two competing parties j, where $j = l, r$. One of the two views v corresponds to the real state of the world $\theta \in \Theta = \{P, G\}$, i.e., either $\theta = G$, if G is the correct view, or $\theta = P$, if P is the correct view. Agents assign each view a subjective probability of $\frac{1}{2}$ to represent the actual state of the world. We assume that ex-ante - without any additional information - no public group can decide which view is correct. Only the party in government is able to find the real state if it is willing to incur information costs $k > 0$. The party that holds office has the ability to find the correct view with certainty because the government has access to information resources which the other public groups (opposition party and voters) usually do not have.[3]

From now on, we will assume that the l-party is currently in office and runs for reelection.

The l-party has both office and economic concerns.[4] The latter may coincide with its partisans' interests. We assume that it adheres to the L-group (partisan group). Additionally, the l-party cares about voter group $M's$ interests. The weight that the party assigns the interests of M relative to the adhered L-group's interests is represented by the factor $\alpha_l \in \{[0,1] \setminus \frac{1}{2}\}$. This factor measures the impact which the consumption levels of the respective voter groups have on the party's utility level. Furthermore, the benefit of holding office if reelected is $B_{\alpha_l} = B$, with $B > 0$. If l is not reelected, then $B_{\alpha_l} = 0$. If l acquires information it has to incur costs of $k_{\alpha_l} = k$, with $k > 0$. If l does not acquire information then $k_{\alpha_l} = 0$. All in all, the state-dependent ($\theta = P$ or $\theta = G$) utility level $U_l^\theta(\alpha_l)$ of the l-party after elections can be described as

$$U_l^\theta(\alpha_l) \quad = \quad B_{\alpha_l} + \alpha_l c_M^\theta + (1-\alpha_l) c_L^\theta - k_{\alpha_l} \tag{7.4}$$

In the following, we take B_{α_l} and k_{α_l} as given and examine which policy w the l-party prefers depending on the real state of the world θ. This means that we focus on the party's economic concerns and assume that it makes no strategic considerations.

Firstly, suppose that θ was P. If we apply equations (7.2) to (7.4), we can conclude that the party would realize the following utility level:

$$U_l^P(\alpha_l) \quad = \quad B_{\alpha_l} + \underline{c} + w\Delta c - k_{\alpha_l} \tag{7.5}$$

If l knew that $\theta = P$, it would always prefer $w = 1$.

[2]For models about political decision processes where there is uncertainty about the consequences of policies, see e.g. Austen-Smith (1990, 1993) or Roemer (1994).

[3]For example, Cukierman and Tommasi (1998) or Lupia (1992) use this type of information asymmetry in their models of information transmission between voters and agenda setters.

[4]That the utility functions of parties can have both office and economic policy components is widely discussed and used in literature, see e.g. Alesina (1987) or Rogoff and Sibert (1988).

In the case of $\theta = G$, we obtain

$$U_l^G(\alpha_l) \quad = \quad B_{\alpha_l} + \underline{c} + \alpha_l \Delta c - (2\alpha_l - 1) w \Delta c - k_{\alpha_l} \tag{7.6}$$

In this case, l would choose $w = 1$ if $\alpha_l < \frac{1}{2}$, and $w = 0$ if $\alpha_l > \frac{1}{2}$.

Thus, with respect to equations (7.5) and (7.6), we can conclude:

If $\alpha_l < \frac{1}{2}$, the party's economic preferences always coincide with the preferences of its partisans. If $\alpha_l > \frac{1}{2}$, its economic preferences always coincide with the preferences of M. Thus, we can interpret α_l as the weight the party assigns to the M-group's consumption level. In the case of $\alpha_l > \frac{1}{2}$, the weight is in favor of M, otherwise it is in favor of the partisan group, L.

Henceforth, we will say that the l-party has "economic concerns" when we generally refer to the components of l's utility function consisting of voter groups' consumption level.

7.2.2 The Voting Game

The l-party is currently in office and runs for reelection. So far, it has implemented policy $w = w_{sq} > \frac{1}{2}$.

In the election campaign parties announce their view v and a corresponding value of the regulation parameter w. Therefore, a party's proposal is a pair (v, w). For convenience, we denote it w^v.[5]

Since M is the only group for which its ideal regulation w depends on θ (see equations (7.2) and (7.3)), whereas L always prefers $w = 1$ and R always wants $w = 0$, M is the decisive voter group. Therefore, to gain a majority of voters, a party must convince the M-group that its view v is the correct one. M-voters are the only group that represents the Median-voter in both possible states of the world.

If a party claims P to be the correct view, the party can only be convincing if it proposes a regulation value w^P that is higher than w_{sq}. The opposite holds if a party proposes G. In that case w^G has to be smaller than w_{sq}.

Since only the incumbent party can know with certainty what the correct view is, only $l's$ announcement is considered by voters although they cannot observe whether l has actually informed. If M accepts $l's$ proposed view, l is reelected.

If M does not find $l's$ proposal convincing, M-voters prefer a change in government and the challenger, the r-party, gains power. One might think of this as a kind of

[5]Roemer (1994) analyzes a voting game where the platform of parties consists of a policy and a theory about the economy, i.e., "the function that maps policies into economic outcomes".

punishment of l for not being convincing as a potentially well informed governmental party. Therefore, M votes for r even if r proposes the same view as l.

We assume that the r-party does not behave strategically. No matter what l announces, the r-party proposes a small P-reform. We denote this proposal by w_r^P, where $w_r^P > w_{sq}$.[6] In the next section, we will give the reasons for this behavior of r.

Furthermore, there are four reform proposals in the political sphere which the governmental l-party can choose from during its campaign: A large G-reform, denoted by w_b^G, a small G-reform, w_s^G, where $w_b^G < w_s^G < w_{sq}$, and a large and a small P-reform, where $w_b^P > w_s^P > w_{sq}$. The order of all possible proposals in the political sphere will be presented and discussed in the next section, Section 7.2.3, as well as in Section 8.2 (Assumption 5 "Order of Proposals", p. 95).

After elections, the winning party actually implements its announced policy proposal.

In addition to the uncertainty of voters concerning the real state of the world, they are also uncertain about the l-party's real preferences, i.e., the parameter α_l. They do not know whether l values higher the interests of its partisans, the L-voters, or the interests of the Median-voters, the M-group. Hence, there are two types of l with different values of α_l. One type which we denote α_l^L favors the L-group, whereas the second type, α_l^M favors M. Therefore, we assume that $\alpha_l^L < \frac{1}{2}$ and $\alpha_l^M > \frac{1}{2}$. (For convenience, we use α_l^L and α_l^M to denote both, the type of l but also the corresponding value of α_l.) The l-party knows its type but all other agents do not. They correctly assign probabilities λ to α_l^L and $(1-\lambda)$ to α_l^M, where $0 < \lambda < 1$.

In the following, we will describe timing and strategies in detail. The relevant players are only l and M because r, L and R do not behave strategically, i.e, their actions do not depend on the actions of the other public groups. We distinguish six stages (the game tree is illustrated in Figure C.1, p. 206):

Stage 1 Nature chooses $l's$ type with probabilities $\text{Prob}(\alpha_l^L) = \lambda$ and $\text{Prob}(\alpha_l^M) = 1-\lambda$. The type is only known to l.

Stage 2 The l-party decides whether to inform about the real state of the world. If l informs, it incurs costs of k. Voters cannot observe whether l gathers information.

Stage 3 Only if l has informed, does it learn the real state of the world with certainty. If it is not informed, l does not learn about θ and assigns subjective probabilities of $\frac{1}{2}$

[6] In Section 10.4, we will analyze the case where r proposes G.

to each possible state (nature draws the correct state). M also assigns $\text{Prob}(P) = \frac{1}{2}$ and $\text{Prob}(G) = \frac{1}{2}$.

Stage 4 Given the information of stage 3, l makes a proposal w^v to the electorate. It can make four proposals: w_b^G, w_s^G, w_s^P, or w_b^P.

Stage 5 M decides whether to accept the proposal. If it is accepted, l is reelected and implements w^v. If M does not accept, r gains power and implements its small reform proposal w_r^P.

Stage 6 The payoff for l is realized. Payoffs for M-voters from consumption are realized.

For their strategic considerations, M-voters and the l-party calculate their (subjective) expected payoffs by equations (7.1), (7.2), (7.3), (7.5), and with $\text{Prob}(P) = \text{Prob}(G) = \frac{1}{2}$.

At stage 2, depending on its type $\alpha_l \in \mathcal{A}_l = \{\alpha_l^L, \alpha_l^M\}$, l has to decide whether to gather information. More precisely, it has to decide about its probability of gathering information. The l-party chooses the action $\imath \in \mathcal{I} = \{i, \bar{i}\}$, where i stands for "inform" and $\bar{i}$ for "not inform". A (behavior) strategy for the l-party must specify a function, we denote it by $\sigma_l^{\mathcal{I}}(\alpha_l)$, which assigns each type α_l of l a probability distribution $\sigma_l(\cdot \mid \alpha_l)$ over $\mathcal{I}$: $\sigma_l^{\mathcal{I}}(\alpha_l) = \sigma_l(\cdot \mid \alpha_l)$. The probability distribution $\sigma_l(\cdot \mid \alpha_l)$ assigns probabilities to each possible action $\imath$. Formally, we can write

$$\sigma_l^{\mathcal{I}} : \quad \alpha_l \longmapsto \sigma_l(\cdot \mid \alpha_l) \tag{7.7}$$

where

$$\sum_{\imath \in \mathcal{I}} \sigma_l(\imath \mid \alpha_l) = 1$$

$\forall \quad \alpha_l \in \mathcal{A}_l$.

At stage 4, the l-party makes a proposal $w^v \in \Pi = \{w_b^G, w_s^G, w_s^P, w_b^P\}$. The proposal w^v which the l-party makes depends on its type, whether it has informed or not, and - if it has informed - on the observed state of the world θ. The l-party defines a function $\sigma_l^{\Pi}(\alpha_l, \imath, \theta)$ which assigns each vector $(\alpha_l, \imath, \theta) \in \mathcal{A}_l \times \mathcal{I} \times \Theta = \mathcal{P}$ a probability distribution $\sigma_l(\cdot \mid \alpha_l, \imath, \theta)$ over Π: $\sigma_l^{\Pi}(\alpha_l, \imath, \theta) = \sigma_l(\cdot \mid \alpha_l, \imath, \theta)$. This means that

$$\sigma_l^{\Pi} : \quad (\alpha_l, \imath, \theta) \longmapsto \sigma_l(\cdot \mid \alpha_l, \imath, \theta) \tag{7.8}$$

where

$$\sum_{w^v \in \Pi} \sigma_l(w^v \mid \alpha_l, \imath, \theta) = 1$$

$\forall \quad (\alpha_l, \imath, \theta) \in \mathcal{P}$.

For example, if $\sigma_l(w_b^P \mid \alpha_l^L, i, P)) = \frac{2}{3}$ and $\sigma_l(w_s^P \mid \alpha_l^L, i, P)) = \frac{1}{3}$ then $l's$ strategy at stage 4 is to play $w^v = w_b^P$ with probability $\frac{2}{3}$ and $w^v = w_s^P$ with probability $\frac{1}{3}$ when it has type α_l^L, and, after it has informed, it learns that $\theta = P$.

After l has announced w^v, the election process is over for the l-party. Hence, a strategy for l can be completely described as a pair $(\sigma_l^{\mathcal{I}}, \sigma_l^{\Pi})$.

At stage 5, M must decide whether it accepts $l's$ proposal w^v. M takes the action $e \in \mathcal{E} = \{a, \bar{a}\}$, where a means "accept the proposal" and $\bar{a}$ means "do not accept the proposal". Stage 5 marks the end of the game. Therefore, $M's$ strategy can be completely defined by a function $\sigma_M^{\mathcal{E}}(w^v)$ which assigns each possible proposal $w^v \in \Pi$ of the l-party a probability distribution $\sigma_M(\cdot \mid w^v)$ over $\mathcal{E}$:

$$\sigma_M^{\mathcal{E}}: \quad w^v \longmapsto \sigma_M(\cdot \mid w^v) \tag{7.9}$$

where

$$\sum_{e \in \mathcal{E}} \sigma_M(e \mid w^v) = 1$$

$\forall \quad w^v \in \Pi$.

7.2.3 The Starting Point: Crisis and Reform Proposals

In order to analyze the phenomenon of a crisis we have to specify the basic conditions in which a crisis can occur. We start with the fundamental assumption of our model.

Assumption 1 (The Real State of the World is G)
From now on, we assume that the real state of the world is G. The correct state G is only known to an informed outside observer. In contrast, agents within the voting model, i.e., voters and political parties, ex-ante do not know what the correct state of the world is. Therefore, the voting game has to be analyzed as if nature drew θ during the game with probabilities $\mathrm{Prob}(P) = \frac{1}{2}$ *and* $\mathrm{Prob}(G) = \frac{1}{2}$.

Economic conditions deteriorate because in the last periods w has been set "according to P", the incorrect view. Meanwhile, the status quo regulation parameter w_{sq} is assumed to be larger than $\frac{1}{2}$, i.e., $w_{sq} > \frac{1}{2}$.

If we say "according to P" we mean that policy is set as if all public groups believed that P was the real state of the world and therefore the optimal regulation for a majority of voters (in this case M and L) would have been implemented. This situation is equivalent to a situation where the M-group alone could decide which regulation parameter is implemented under the assumption that M-voters believed that the real state of the world was P. In this sense, the M-group is representative for a majority of voters because it is the decisive group: R-voters always vote for $w = 0$, i.e., minimal regulation, and L-voters always vote for $w = 1$, i.e., maximal regulation (see equations (7.2) and (7.3)). Only the optimal choice for M depends on what M believes is the correct view of the economy.

If policy is set according to P but the real state of the world is G, a crisis can occur since a majority of voters, the R-group and the M-group, experiences a reduction in their consumption levels, which they wouldn't have suffered if policy was made in accordance with the correct view, i.e., G. In a crisis, not all groups have to be worse off. Even in difficult economic situations there may always be a subgroup of society that gains from the deterioration, although this group may be relatively small.

We interpret P as a longstanding viewpoint which has developed over a large period of time. It could prevail because it was the correct view in the past. Recently however, basic conditions, economically, politically or both, have changed.[7] As a consequence, P is no longer an appropriate description of reality, and thus, suggests the wrong policy. This is not clear to society ex-ante. The public observes economic problems and starts a debate over whether P is still correct. Under these conditions, the G-view emerges as an alternative in the public discussion.

We assume that information about the actual state of the world is uncertain for voters because the economic situation is so complex that most people are not able to inform themselves, e.g., because of time or budget restrictions. Therefore, society needs people who specialize in gaining knowledge about the economy. We call these people "experts". But even experts are not able to communicate "hard information" about economic facts. The reason is twofold. Firstly, the information is not verifiable by voters in the end. Experts are valuable since they can reduce the space of possible policy alternatives but the remaining alternatives are still too complex to be verified per se. Secondly, the goals of experts on the one hand and voters on the other hand may diverge. Experts may be interest-driven, and hence, their proposals have limited credibility. *Nevertheless, we assume that voters and parties do not take into account strategic considerations of experts.* They take the policy proposals of experts as an exogenous set of possible reforms which contains the actual state of the world with certainty. Therefore, the incumbent party is restricted to experts' proposals. Although the party in office can learn the correct state of the world if it wants to, the correct view can only be transmitted via signaling to voters, since the party also has self-interests.[8]

[7] One might think of the implications of the so-called "globalization" or the change from a central planned economy to a capitalist system in Eastern Europe.

[8] Gilligan (1993) discusses the role of experts when legislators have to acquire complex information for their decisions. Information transmission between experts and legislators can be imperfect because

Besides self-interests some experts may propose the wrong policy, because the complexity makes it difficult to decide whether the detrimental economic development stems from a wrongly chosen value of a regulation parameter or from exogenous factors that are change-inherent. Some experts may argue that P-policy was right, and things would improve if exogenous conditions improve. G-policy could even worsen the situation.

Furthermore, experts not only argue about P or G, they also argue about the appropriate size of reform that could end the crisis. On both sides we have proponents for a small reform and proponents for a large reform. Experts that favor P together with a small reform propose a regulation parameter w_s^P, whereas large reform proponents call for w_b^P, where $w_b^P > w_s^P > w_{sq}$. The small reform supporters of the G-view propose w_s^G, the large reform supporters announce w_b^G to be the best way out of crisis. The G-proposals are ordered in the following way: $w_b^G < w_s^G < w_{sq}$.

Several reasons for reform proposals of experts which differ from $w^G = 0$ or $w^P = 1$ are conceivable. Although an expert believes that equations (7.2) or (7.3) are correct he could favor a smaller reform on strategic grounds: It could be more likely to be implemented than the largest possible reforms $w^G = 0$ or $w^P = 1$ because of voters' risk aversion. Experts could also have some idea of social fairness that excludes a policy where one voter group has the minimum consumption level while the other two enjoy the maximum. Furthermore, some experts may not be really confident about their announced view and thus may make a careful proposal.

Voters, like some experts, cannot distinguish between possible effects of regulation and exogenous factors. They have a short memory, and usually do not contemplate economic theories. Instead, they delegate this task to the party in office, and contemplate the credibility[9] of the incumbent party's proposals.

In contrast, the opposition party is not able to learn of the correct view since it does not have the information resources the governmental party has. Therefore, we assume that the challenger adheres to the policies of the past. This behavior can be easily explained by behavioral phenomena like conservatism or sluggishness discussed in Chapter 2 "Conceptual Issues".

of different preferences and un-verifiability of the information. Hahn (2002) uses this type of soft information in models involving information transmission between central banks and the public. In contrast, hard information is verifiable or the sender and receiver have the same preferences.

[9] Exactly what we mean by credibility is discussed in Section 8.3.2, Definition 10, p. 101.

Chapter 8

Equilibrium Concept and Best Responses

8.1 Equilibrium Concept

The described voting game is an extensive form game with incomplete information. The appropriate solution concept is that of a sequential equilibrium developed by Kreps and Wilson (1982). For convenience, we make the following definition:

Definition 3 (Equilibrium and Sequential Equilibrium)
Henceforth, we use both terms "sequential equilibrium" or just "equilibrium" to denote an equilibrium derived by the Nash solution concept of a sequential equilibrium introduced by Kreps and Wilson (1982).

The concept of a sequential equilibrium assures subgame perfection and "reasonable" out-off-equilibrium beliefs. A sequential equilibrium is a pair (σ^*, μ^*) of strategies σ^* and beliefs μ^* that requires:

Firstly, a player's actions are sequentially rational given a system of beliefs μ^*. This means that a player's actions are optimal at each information set he could reach, given what the player believes has already occurred (according to μ^*) and given the further actions of all other players. It is important to note that sequential rationality requires optimal behavior at any possible information set, no matter whether it is on or off the equilibrium path.

Secondly, the system of beliefs μ^* is the limit of a sequence of beliefs $\{\mu^k\}_{k=1}^{\infty}$ which are derived by Bayes' rule from a sequence of totally mixed strategies $\{\sigma^k\}_{k=1}^{\infty}$ with $\lim_{k\to\infty} \sigma^k = \sigma^*$. This requirement assures that beliefs are consistent with strategies and beliefs are reasonable even off the equilibrium path.

If we apply these conditions to our game, an equilibrium strategy $((\sigma_l^{\mathcal{I}})^*, (\sigma_l^{\Pi})^*)$ for l has to be optimal given the strategy $\sigma_M^{\mathcal{E}}$ of M. Because l always knows what it has done before (perfect recall), and all its actions are completed when M makes its first (and last) move, l does not have to create beliefs.[1] On the other hand, when M observes $l's$ proposal, for example w_b^G, the M-voter has to form a belief about the node belonging to the "w_b^G-information set" where he has to act (see Figure C.1 "The game tree", p. 206). The belief μ^* is the posteriori probability distribution over $\mathcal{P}$, given w^v. In particular, M assigns a probability to a proposed view that it obtains from a corresponding "correct" node of l, i.e. that $l's$ proposed view reflects the real state of the world. This is what we can interpret as credibility of a proposal: Credibility is the probability according to M of a proposed view being correct given $l's$ strategy.

The belief that M creates is derived from a sequence of strategies from l which converge to $l's$ equilibrium strategy. We will see below that as long as w^v corresponds to $l's$ equilibrium strategy, beliefs can be created directly from this equilibrium strategy. On the equilibrium path, the concept of sequential equilibrium coincides with that of a perfect Bayesian equilibrium. But in a perfect Bayesian equilibrium, no restrictions are placed on beliefs off the equilibrium path, i.e., at information sets that are not reached with strictly positive probability by playing the equilibrium strategies. M could assign any belief to an unexpected proposal w^v of l. However, in a sequential equilibrium these beliefs have to be justified by some "story" that leads to the unexpected proposal. This story is incorporated by $\{(\sigma_l^{\mathcal{I}})^k, (\sigma_l^{\Pi})^k\}_{k=1}^{\infty}$, where $\lim_{k\to\infty}((\sigma_l^{\mathcal{I}})^k, (\sigma_l^{\Pi})^k) = ((\sigma_l^{\mathcal{I}})^*, (\sigma_l^{\Pi})^*)$. If w^v is unexpected, M could ask how l comes to w^v. The answer could be that l made a mistake in the sense of a small perturbation $((\sigma_l^{\mathcal{I}})^k, (\sigma_l^{\Pi})^k)$ of the equilibrium strategy.

By using backward induction for l, we can assure optimal action at any possible information set. A sequential equilibrium $((\sigma_l^{\mathcal{I}})^*, (\sigma_l^{\Pi})^*, (\sigma_M^{\mathcal{E}})^*, \mu^*)$ of the voting game requires for the equilibrium strategies $((\sigma_l^{\mathcal{I}})^*, (\sigma_l^{\Pi})^*)$ of the l-party that

$$(i) \quad \text{at stage 4} \quad \forall \quad (\alpha_l, \imath, \theta) \in \mathcal{P}:$$

$$\sigma_l^*(\cdot \mid \alpha_l, \imath, \theta) \in \underset{\sigma_l(\cdot \mid \alpha_l, \imath, \theta)}{\operatorname{argmax}} E\Big[U_l\big(\sigma_l(\cdot \mid \alpha_l, \imath, \theta), (\sigma_M^{\mathcal{E}})^*\big)\Big] \tag{8.1}$$

and

$$(ii) \quad \text{at stage 2} \quad \forall \quad \alpha_l \in \mathcal{A}_l:$$

$$\sigma_l^*(\cdot \mid \alpha_l) \in \underset{\sigma_l(\cdot \mid \alpha_l)}{\operatorname{argmax}} E\Big[U_l\big(\sigma_l(\cdot \mid \alpha_l), (\sigma_l^{\Pi})^*, (\sigma_M^{\mathcal{E}})^*\big)\Big] \tag{8.2}$$

[1]The subjective probability about the real state of the world can be interpreted as a given belief.

The equilibrium strategy $(\sigma_M^{\mathcal{E}})^*$ for M-voters in a sequential equilibrium must satisfy

$$\begin{aligned}
&(iii) \quad \text{at stage 5} \quad \forall \quad w^v \in \Pi : \\
&\sigma_M^*(\cdot \mid w^v) \in \quad \underset{\sigma_M(\cdot|w^v)}{\text{argmax}} \quad E\Big[U_M\big((\sigma_l^{\mathcal{I}})^*, (\sigma_l^{\Pi})^*, \sigma_M(\cdot \mid w^v)\big)\Big] = \\
&\underset{\sigma_M(\cdot|w^v)}{\text{argmax}} \sum_{(\alpha_l, \imath, \theta) \in \mathcal{P}} \mu^*(\alpha_l, \imath, \theta \mid w^v) \cdot U_M\big(\sigma_M(\cdot \mid w^v)\big)
\end{aligned} \tag{8.3}$$

where

$$\begin{aligned}
&\mu^*(\alpha_l, \imath, \theta \mid w^v) = \\
&\lim_{k \to \infty} \frac{\text{Prob}(\alpha_l) \cdot \sigma_l^k(\imath \mid \alpha_l) \cdot \text{Prob}(\theta) \cdot \sigma_l^k(w^v \mid \alpha_l, \imath, \theta)}{\sum\limits_{(\alpha_l', \imath', \theta') \in \mathcal{P}} \text{Prob}(\alpha_l') \cdot \sigma_l^k(\imath' \mid \alpha_l') \cdot \text{Prob}(\theta') \cdot \sigma_l^k(w^v \mid \alpha_l', \imath', \theta')}
\end{aligned} \tag{8.4}$$

If w^v is played in equilibrium, there exists at least one $(\alpha_l, \imath, \theta) \in \mathcal{P}$ such that

$$\begin{aligned}
&\lim_{k \to \infty} \sigma_l^k(\imath \mid \alpha_l) \cdot \sigma_l^k(w^v \mid \alpha_l, \imath, \theta) = \\
&\sigma_l^*(\imath \mid \alpha_l) \cdot \sigma_l^*(w^v \mid \alpha_l, \imath, \theta) > 0
\end{aligned}$$

Thus, if w^v is proposed in equilibrium, (8.4) simplifies to

$$\begin{aligned}
&\mu^*(\alpha_l, \imath, \theta \mid w^v) = \\
&\frac{\text{Prob}(\alpha_l) \cdot \sigma_l^*(\imath \mid \alpha_l) \cdot \text{Prob}(\theta) \cdot \sigma_l^*(w^v \mid \alpha_l, \imath, \theta)}{\sum\limits_{(\alpha_l', \imath', \theta') \in \mathcal{P}} \text{Prob}(\alpha_l') \cdot \sigma_l^*(\imath' \mid \alpha_l') \cdot \text{Prob}(\theta') \cdot \sigma_l^*(w^v \mid \alpha_l', \imath', \theta')}
\end{aligned} \tag{8.5}$$

8.2 Equilibrium Selection Criteria and other Assumptions

In this section we make some assumptions concerning the selection of sequential equilibria and parameter values. We will discuss the relaxation of these assumptions in Section 10.7. Most of them do not change the basic results we obtain.

Firstly, we will make the following assumption:

Assumption 2
We will only consider equilibria where $\sigma_M(a \mid w^v) > 0$ for at least one proposal.

As will be discussed in Section 10.7, equilibria where all proposals are rejected with certainty are not very plausible since at least the small G-proposal should be credible enough to be approved.

Furthermore, we assume that if M accepts both a small and a large reform of a certain view with strictly positive probability, M accepts them with the same probability. The interpretation of our assumption is that, for example, M could make an announcement in the following way: "If I am willing to accept (with positive probability) both a small and a large P-reform, I do not differentiate between a regulation parameter of, say 0.6 or 0.8, because I am not an expert and I trust the governing party to find the best value."

Assumption 3
We will only consider equilibria where $\sigma_M(a \mid w_s^v) = \sigma_M(a \mid w_b^v)$, if $\sigma_M(a \mid w^v) > 0$ for both the large and the small reform of view v, i.e., for w_s^v and w_b^v, .

Additionally, we assume that the l-party does not mix its proposals in equilibrium.

Assumption 4
We will only consider equilibria with best response proposals in pure strategies.

Finally, in subsequent sections, we will make assumptions concerning which proposals l will make in the case of indifference and assumptions concerning out-off-equilibrium beliefs.

For the values of proposals, we firstly assume, that a small G-reform is "very" small, i.e. $w_s^G > \frac{1}{2}$, and a large G-reform is "very" large, i.e $w_b^G < \frac{1}{2}$. Secondly, $r's$ small reform proposal is more careful than $l's$ small reform proposal. This is in accordance with intuition since it is not possible for the r-party to learn about θ. We summarize the relations between the values of proposals in the following assumption.

Assumption 5 (Order of Proposals)
$0 \leq w_b^G < \frac{1}{2} < w_s^G < w_{sq} < w_r^P < w_s^P < w_b^P \leq 1$

As we will also see in further analysis, the assumption of only two parameter values for each view does not lower insights into the model. More than two possible values would not change l's best response to a given strategy of M.[2]

Our last assumption in this section refers to B, the benefit the party obtains from holding office. We assume that B is larger than the maximal possible change in voters' consumption level by reform. This reflects the empirical fact that office holders, e.g., prime ministers, usually earn much more than the average citizen. Additionally, this assumption excludes the possibility that the l-party sacrifices reelection just for economic concerns. A further discussion of this point can be found in Section 10.7.

Assumption 6
$B > \Delta c \cdot \max_{w^v} |w^v - w_r^P|$.

[2]The l-party almost always chooses the highest w^v-values that M accepts with positive probability. It would never respond with a w^v-value that lies in the middle of the parameter area that M accepts with positive probability.

For ease of presentation, we now introduce $w^{G,u}$, $w^{G,o}$, $w^{P,u}$, and $w^{P,o}$ as strategic variables of M. We denote by $w^{G,o}$ the higher value of a G-proposal which M would accept with strictly positive probability, by $w^{G,u}$ we denote the lower value which M would accept with strictly positive probability. For example, if M accepts both G-proposals, $w^{G,o}$ corresponds to the small G-reform which has the higher parameter value w_s^G. If M does not accept any G-proposal, $w^{G,o}$ is the higher value l can choose, and $w^{G,u}$ the lower. The variables $w^{P,o}$ and $w^{P,u}$ are defined accordingly. This can be summarized in the following definition.

Definition 4
Suppose M plays strategy $\sigma_M^{\mathcal{E}}$. We define for M the strategic variables $w^{G,u}$, $w^{G,o}$, $w^{P,u}$, and $w^{P,o}$ in the following way:

- *If $\sigma_M(a \mid w_b^G) = \sigma_M(a \mid w_s^G) > 0$ or $\sigma_M(a \mid w_b^G) = \sigma_M(a \mid w_s^G) = 0$, then $w^{G,o} = w_s^G$ and $w^{G,u} = w_b^G$.*
  If $\sigma_M(a \mid w_b^P) = \sigma_M(a \mid w_s^P) > 0$ or $\sigma_M(a \mid w_b^P) = \sigma_M(a \mid w_s^P) = 0$, then $w^{P,o} = w_b^P$ and $w^{P,u} = w_s^P$.
- *If $\sigma_M(a \mid w_b^G) > 0$ and $\sigma_M(a \mid w_s^G) = 0$, then $w^{G,o} = w^{G,u} = w_b^G$.*
  If $\sigma_M(a \mid w_b^P) > 0$ and $\sigma_M(a \mid w_s^P) = 0$, then $w^{P,o} = w^{P,u} = w_b^P$.
- *If $\sigma_M(a \mid w_b^G) = 0$ and $\sigma_M(a \mid w_s^G) > 0$, then $w^{G,o} = w^{G,u} = w_s^G$.*
  If $\sigma_M(a \mid w_b^P) = 0$ and $\sigma_M(a \mid w_s^P) > 0$, then $w^{P,o} = w^{P,u} = w_s^P$.

If we combine Definition 4 and Assumption 3 it always holds that $\sigma_M(a \mid w^{G,u}) = \sigma_M(a \mid w^{G,o})$ and that $\sigma_M(a \mid w^{P,u}) = \sigma_M(a \mid w^{P,o})$. Therefore, we can make the following definition for convenience:

Definition 5

$$\sigma_M^G := \sigma_M(a \mid w^{G,u}) = \sigma_M(a \mid w^{G,o})$$
$$\sigma_M^P := \sigma_M(a \mid w^{P,u}) = \sigma_M(a \mid w^{P,o})$$

Note that with Assumption 3 and Definitions 4 and 5, a strategy of M can be completely described by $w^{G,u}$, $w^{G,o}$, σ_M^G, $w^{P,u}$, $w^{P,o}$, and σ_M^P.

8.3 Best Responses and Beliefs

8.3.1 The l-Party's Best Responses

The fundamental question for the l-party is which view it should propose. For its decision, l has to take into account the two components of its utility function: The economic component, represented by consumption levels of L and M, and the office component, represented by benefit B from holding office.

Firstly, we consider best responses of the α_l^L-type. This type's economic policy preferences coincide in each state of the world with the prefernces of the L-group (see equations (7.5) and (7.6)). On economic concerns, it will always choose a regulation parameter as high as possible, i.e. it will choose $w^{P,o}$ and not $w^{P,u}$ (if they differ) or $w^{G,o}$ and not $w^{G,u}$ (if they differ).

As long as $\sigma_M^P \geq \sigma_M^G$, α_l^L will always choose the highest value M is willing to accept, i.e., α_l^L will choose $w^{P,o}$. Because the probability of being elected is at least as large with a P-proposal as with a G-proposal, α_l^L has no reason to propose G. Furthermore, α_l^L will not inform since there is no reason to incur information costs if α_l^L proposes $w^{P,o}$ even if it knew that $\theta = G$.

In the case of $\sigma_M^P < \sigma_M^G$ there is a trade-off between economic and office concerns. If σ_M^G is large enough, α_l^L could choose $w^{G,o}$ and not $w^{P,o}$ since the value B of reelection could be very high relative to the value of L-consumption. In this case, information could have a value for α_l^L. If α_l^L knew that $\theta = P$, then better chances of reelection by proposing $w^{G,o}$ would not be worthwhile. The loss of implementing $w^{G,o}$ could be high because M would also lose. Furthermore, a P-policy would be implemented by the r-party anyway. On the other hand, if α_l^L knew that $\theta = G$ the net economic policy loss would be relatively small since the M-group would gain from implementing $w^{G,o}$. To sum up, the l-party could gain from proposing $w^{G,o}$, since it increases chances of being reelected.

Economic policy preferences of the α_l^M-type depend on the real state of the world, since this type favors M-interests in each case. Therefore, information can always be valuable for α_l^M.

If α_l^M does not inform, it will always choose the higher level of regulation independent of its proposed view. We can see this if we compute the expected utility level for α_l^M according to equations (7.5) and (7.6) if α_l^M proposes w^v. Because we want to focus on economic concerns we assume that $\sigma_M^P = \sigma_M^G = 1$.

$$
\begin{aligned}
&E\left[U_l\left(\sigma_l(w^v \mid \alpha_l^M, \bar{\imath}, \theta) = 1, \sigma_M^P = 1, \sigma_M^G = 1\right)\right] \\
&= \frac{1}{2}U_l^P(\alpha_l^M) + \frac{1}{2}U_l^G(\alpha_l^M) \\
&= \frac{1}{2}\big(B + \underline{c} + w^v\Delta c\big) + \frac{1}{2}\big(B + \underline{c} + \alpha_l^M\Delta c - (2\alpha_l^M - 1)w^v\Delta c\big) \qquad (8.6) \\
&= B + \underline{c} + \frac{1}{2}\alpha_l^M\Delta c + (1 - \alpha_l^M)w^v\Delta c \qquad (8.7)
\end{aligned}
$$

If α_l^M chooses the higher regulation level instead of the lower level then the weighted aggregate consumption level increases more in the case of $\theta = P$ than it decreases in the case of $\theta = G$ (see (8.6): $w\Delta c$ if $\theta = P$ versus $(2\alpha_l^M - 1)w\Delta c$ if $\theta = G$ and $\alpha_l^M > \frac{1}{2}$). Because of the party's risk neutrality it maximizes the expected utility level if it proposes the highest possible regulation level. Intuitively, even the α_l^M-type tends towards proposing more regulation if it has not informed because L always prefers more regulation whereas M prefers less regulation only if $\theta = G$.

In the case of $\sigma_M^P \geq \sigma_M^G$, α_l^M will choose $w^{P,o}$ if it does not inform because of both reelection concerns and economic concerns (see equation (8.6)). The α_l^M-type will only inform if learning $\theta = G$ and proposing G not only outweigh information costs k but also outweigh lower chances of being reelected. Obviously, in the case of informing, and if α_l^M learns that the real state of the world is G, it will propose on economic grounds $w^{G,u}$.

If $\sigma_M^P < \sigma_M^G$ and α_l^M does not inform then there is a trade-off between office and economic policy concerns. With respect to economic concerns α_l^M would propose $w^{P,o}$ (equation (8.7)) but with respect to chances of reelection α_l^M would propose $w^{G,o}$. This type has a lot more incentives to inform than the α_l^L-type in the case of $\sigma_M^P < \sigma_M^G$ because if α_l^M learned that $\theta = G$ it would gain and not lose economically by proposing and implementing G. Of course, if α_l^M knows that $\theta = G$ it will choose the lowest possible regulation level, i.e. $w^{G,u}$. On the other hand, if α_l^M learned that $\theta = P$ much higher chances of reelection could outweigh economic concerns and α_l^M would choose to propose $w^{G,o}$.

In Tables C.1 and C.2, we give an exact overview of $l's$ best responses depending on M's strategy and parameter values $B, k, \alpha_l^L, \alpha_l^M, \Delta c$, and w_r^P. The derivation of $l's$ best responses can be found in Appendix B.1. There, and in all subsequent analysis, we will use the following definitions for ease of presentation:

Definition 6

$$\begin{aligned}\beta_L &:= |2\alpha_l^L - 1| \\ \beta_M &:= |2\alpha_l^M - 1| \\ \Delta w^v &:= |w^v - w_r^P|\end{aligned}$$

Definition 7

$$\begin{aligned}\Delta\sigma_M &:= \sigma_M^G - \sigma_M^P \\ \Sigma_M^u &:= \sigma_M^G \Delta w^{G,u} + \sigma_M^P \Delta w^{P,u} \\ \Sigma_M^o &:= \sigma_M^G \Delta w^{G,o} + \sigma_M^P \Delta w^{P,o}\end{aligned}$$

Definition 8

$$\begin{aligned}\sigma_{iL} &:= \sigma_l(i \mid \alpha_l^L) \\ \sigma_{iM} &:= \sigma_l(i \mid \alpha_l^M)\end{aligned}$$

Definition 9
Suppose M plays strategy $\sigma_M^{\mathcal{E}}$.

We define the vector $\tilde{\sigma}_l^{\Pi}(\alpha_l)$ of best response proposals in pure strategies for l: It is a triple consisting of proposals w^v satisfying

$\big(\sigma_l(\cdot \mid \alpha_l, i, G) = 1, \sigma_l(\cdot \mid \alpha_l, i, P) = 1, \sigma_l(\cdot \mid \alpha_l, \bar{i}, \theta) = 1\big)$

For example, if

$\big(\sigma_l(w^{G,u} \mid \alpha_l^M, i, G) = 1, \sigma_l(w^{P,o} \mid \alpha_l^M, i, P) = 1, \sigma_l(w^{G,o} \mid \alpha_l^M, \bar{i}, \theta) = 1\big),$

then

$$\tilde{\sigma}_l^{\Pi}(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$$

That is, if α_l^M informs and learns that $\theta = G$, it will propose $w^{G,u}$, if it informs and learns that $\theta = P$, it will propose $w^{P,o}$, and if α_l^M does not inform, it will propose $w^{G,o}$.

Proposition 8 (The l-Party's Best Responses)
Suppose M plays strategy $\sigma_M^{\mathcal{E}}$ described by $w^{G,u}$, $w^{G,o}$, σ_M^G, $w^{P,u}$, $w^{P,o}$, and σ_M^P. In this case, the l-party's best responses are given by Tables C.1 and C.2.

The tables' entries follow from Lemmas 21 to 28 (see Appendix B.1.2).

The tables describe the l-party's best responses depending on parameter constellations and M's strategy. There are 7 different regions of parameter and strategy constellations - called Areas I to VII - with different best response proposals. The areas refer to the level of $B\Delta\sigma_M$. In the 2nd column are the corresponding conditions. The 3rd column names best response proposals belonging to these constellations. The 4th column gives the conditions under which l will inform, i.e. decides that the best response to M's strategy would be to enter the state of information. If these conditions are fulfilled with equality, e.g. for Area I, if $\alpha_l^M = \frac{1}{2} + \frac{k}{\sigma_M^G \Delta c(w^{G,o} - w^{G,u})}$, the α_l^M-type is indifferent concerning its information decision. If $\alpha_l^M < \frac{1}{2} + \frac{k}{\sigma_M^G \Delta c(w^{G,o} - w^{G,u})}$, it will never gather information.

If $B\Delta\sigma_M$ equals the areas' borders, and best response proposals for a type of l are different for the two areas next to each other, the corresponding type is indifferent concerning which proposal to play. In the tables we assume that both types of l play the higher value of w in the case of indifference. In Section 10.7, we will discuss the consequences when we allow both possible proposals to be played. We will see that there will be no substantial effects on the results of our analysis. Finally, note that in the case of indifference between proposals, both information conditions are valid. They lead to the same information decision.

Furthermore, Tables C.1 and C.2 tell us the following facts:

- The areas' borders depend on the relationship between α_l^L and α_l^M, i.e. whether $(1 - \alpha_l^M)$ is at least as large as $(1 - 2\alpha_l^L)$ or not. This is relevant in Areas III, IV, and V. The first lines in the 2nd column of the corresponding Areas give the conditions for the named best response proposals if $(1 - \alpha_l^M) \geq (1 - 2\alpha_l^L)$. The second line gives the areas' borders if the opposite holds. But only in Area IV do best response proposals depend on this relationship. If $(1-\alpha_l^M) \geq (1-2\alpha_l^L)$, best responses are given in IVa. Otherwise they are given in IVb. In the following analyses we will skip the notation "a" and "b" for Areas III to V if they are irrelevant for argumentation.

- For a given σ_M^G and as long as $\sigma_M^G > \sigma_M^P \geq 0$, the Roman number of the relevant area increases if σ_M^P increases, because $B\Delta\sigma_M$ decreases and $\Delta c\Sigma_M^o$ increases for a larger σ_M^P. We can see from the column of best response proposals, that l makes a G-proposal only if the relative advantage of being reelected by proposing G instead of P is large enough. If σ_M^G and σ_M^P are close enough (Area V), only an informed α_l^M-type will continue to propose a G-policy. In the case of $\sigma_M^P \geq \sigma_M^G$ and if σ_M^P is too large, even the informed α_l^M-type will not propose G (Area VII).

8.3.2 The M-Group's Best Responses and Beliefs

In this section we discuss the M-group's beliefs and the corresponding best responses.

Before its decision whether to approve a proposal w^v, the M-group has to build beliefs about the correctness of the proposed view. Depending on the l-party's strategy $(\sigma_l^{\mathcal{I}}, \sigma_l^{\Pi})$ and the resulting beliefs, M chooses its best response, i.e. $\sigma_M(a \mid w^v)$.

For M, the expected utility of playing $\sigma_M(a \mid w^v)$ given a strategy $(\sigma_l^{\mathcal{I}}, \sigma_l^{\Pi})$ with proposal w^v is (see (8.3)):

$$
\begin{aligned}
&E\Big[U_M\big(\sigma_l^{\mathcal{I}}, \sigma_l^{\Pi}, \sigma_M(a \mid w^v)\big)\Big] = \\
&\sum_{(\alpha_l,\imath,\theta)\in\mathcal{P}} \mu(\alpha_l, \imath, \theta \mid w^v) \cdot U_M\big(\sigma_M(a \mid w^v)\big) = \\
&\sum_{(\alpha_l,\imath,G)\in\mathcal{P}} \mu(\alpha_l, \imath, G \mid w^v) \Big(\sigma_M(a \mid w^v)\sqrt{\bar{c} - w^v\Delta c} + \big(1 - \sigma_M(a \mid w^v)\big)\sqrt{\bar{c} - w_r^P\Delta c}\Big) + \\
&\sum_{(\alpha_l,\imath,P)\in\mathcal{P}} \mu(\alpha_l, \imath, P \mid w^v) \Big(\sigma_M(a \mid w^v)\sqrt{\underline{c} + w^v\Delta c} + \big(1 - \sigma_M(a \mid w^v)\big)\sqrt{\underline{c} + w_r^P\Delta c}\Big) = \\
&\sigma_M(a \mid w^v)\left[\left(\sum_{(\alpha_l,\imath,G)\in\mathcal{P}} \mu(\alpha_l, \imath, G \mid w^v)\right)\left\{\sqrt{\bar{c} - w^v\Delta c} - \sqrt{\bar{c} - w_r^P\Delta c}\right\} + \right.\\
&\left.\left(\sum_{(\alpha_l,\imath,P)\in\mathcal{P}} \mu(\alpha_l, \imath, P \mid w^v)\right)\left\{\sqrt{\underline{c} + w^v\Delta c} - \sqrt{\underline{c} + w_r^P\Delta c}\right\}\right] + \\
&\left(\sum_{(\alpha_l,\imath,G)\in\mathcal{P}} \mu(\alpha_l, \imath, G \mid w^v)\right)\sqrt{\bar{c} - w_r^P\Delta c} + \left(\sum_{(\alpha_l,\imath,P)\in\mathcal{P}} \mu(\alpha_l, \imath, P \mid w^v)\right)\sqrt{\underline{c} + w_r^P\Delta c}
\end{aligned}
\tag{8.8}
$$

Firstly, we define the credibility of a proposal v as the total sum of beliefs $\mu(\alpha_l, \imath, \theta \mid w^v)$ with $\theta = v$.

Definition 10 (Credibility of a Proposal)
The credibility $\mu(\theta = v \mid w^v)$ of a proposal w^v is the a posteriori probability M assigns this proposal, so that it represents the correct state of the world.

$$\mu(\theta = v \mid w^v) := \sum_{(\alpha_l,\imath,\theta=v)\in\mathcal{P}} \mu(\alpha_l, \imath, \theta = v \mid w^v)$$

For example, observing proposal w^v, $\sum_{(\alpha_l,\imath,G)\in\mathcal{P}} \mu(\alpha_l, \imath, G \mid w^v)$ is the total probability M assigns to the possibility that the real state of the world is G. If the proposal is a G-proposal, this sum represents the credibility of this proposal.

Furthermore, if v was a G-proposal, $\sqrt{\bar{c} - w^G\Delta c} - \sqrt{\bar{c} - w_r^P\Delta c}$ in (8.8) would be positive because $w^G < w_r^P$. On the other hand, $\sqrt{\underline{c} + w^G\Delta c} - \sqrt{\underline{c} + w_r^P\Delta c}$ would be negative. M would accept the proposal if the whole expression in square brackets of (8.8) was positive.

In general, M would be indifferent in accepting a w^v-proposal if

$$\left(\sum_{(\alpha_l,\imath,G)\in\mathcal{P}} \mu(\alpha_l,\imath,G \mid w^v)\right)\left\{\sqrt{\bar{c}-w^v\Delta c}-\sqrt{\bar{c}-w_r^P\Delta c}\right\}+$$
$$\left(\sum_{(\alpha_l,\imath,P)\in\mathcal{P}} \mu(\alpha_l,\imath,P \mid w^v)\right)\left\{\sqrt{\underline{c}+w^v\Delta c}-\sqrt{\underline{c}+w_r^P\Delta c}\right\}=0 \tag{8.9}$$

We define $\tilde{\mu}_G(w^G)$ as the minimum credibility M must assign a w^G-proposal to approve it, i.e. $\tilde{\mu}_G(w^G) := \sum_{(\alpha_l,\imath,G)\in\mathcal{P}} \mu(\alpha_l,\imath,G \mid w^G)$, where $\sum_{(\alpha_l,\imath,G)\in\mathcal{P}} \mu(\alpha_l,\imath,G \mid w^G)$ satisfies (8.9). (Note, that $\sum_{(\alpha_l,\imath,P)\in\mathcal{P}} \mu(\alpha_l,\imath,P \mid w^G) = 1-\sum_{(\alpha_l,\imath,G)\in\mathcal{P}} \mu(\alpha_l,\imath,G \mid w^G)$.) Defining $\tilde{\mu}_P(w^P)$ accordingly we obtain

Definition 11 (Minimum Credibility Requirements)
The minimum credibility M must assign a G-proposal to approve it is $\tilde{\mu}_G(w^G)$ where

$$\tilde{\mu}_G(w^G)=\frac{\sqrt{\underline{c}+w^G\Delta c}-\sqrt{\underline{c}+w_r^P\Delta c}}{\sqrt{\underline{c}+w^G\Delta c}-\sqrt{\underline{c}+w_r^P\Delta c}-\sqrt{\bar{c}-w^G\Delta c}+\sqrt{\bar{c}-w_r^P\Delta c}}.$$

The minimum credibility M must assign a P-proposal to approve it is $\tilde{\mu}_P(w^P)$ where

$$\tilde{\mu}_P(w^P)=\frac{\sqrt{\bar{c}-w_r^P\Delta c}-\sqrt{\bar{c}-w^P\Delta c}}{\sqrt{\underline{c}+w^P\Delta c}-\sqrt{\underline{c}+w_r^P\Delta c}-\sqrt{\bar{c}-w^P\Delta c}+\sqrt{\bar{c}-w_r^P\Delta c}}.$$

The characteristics of these functions are summarized in the following proposition (for proof see Appendix B.2, a sketch of the functions can be found in Figure 8.1). We state the characteristics not only for the current case, $w_r^P > \frac{1}{2}$, but also for the case that we analyze in a later section (Section 10.5) where we assume that $w_r^P < \frac{1}{2}$.

Proposition 9 (Characteristics of Minimum Credibility Requirements)
$\tilde{\mu}_G(w^G)$ is continuous in $w^G \in \{[0,1]\backslash w_r^P\}$. $\tilde{\mu}_P(w^P)$ is continuous in $w^P \in \{[0,1]\backslash w_r^P\}$.

(i) If $w_r^P > \frac{1}{2}$, we obtain:

$$\tilde{\mu}_G(w^{G*})<\frac{1}{2} \quad \textit{for any} \quad w^{G*}\in(\frac{1}{2},w_r^P) \quad \textit{and}$$
$$\tilde{\mu}_P(w^{P*})>\frac{1}{2} \quad \textit{for any} \quad w^{P*}\in(w_r^P,1].$$

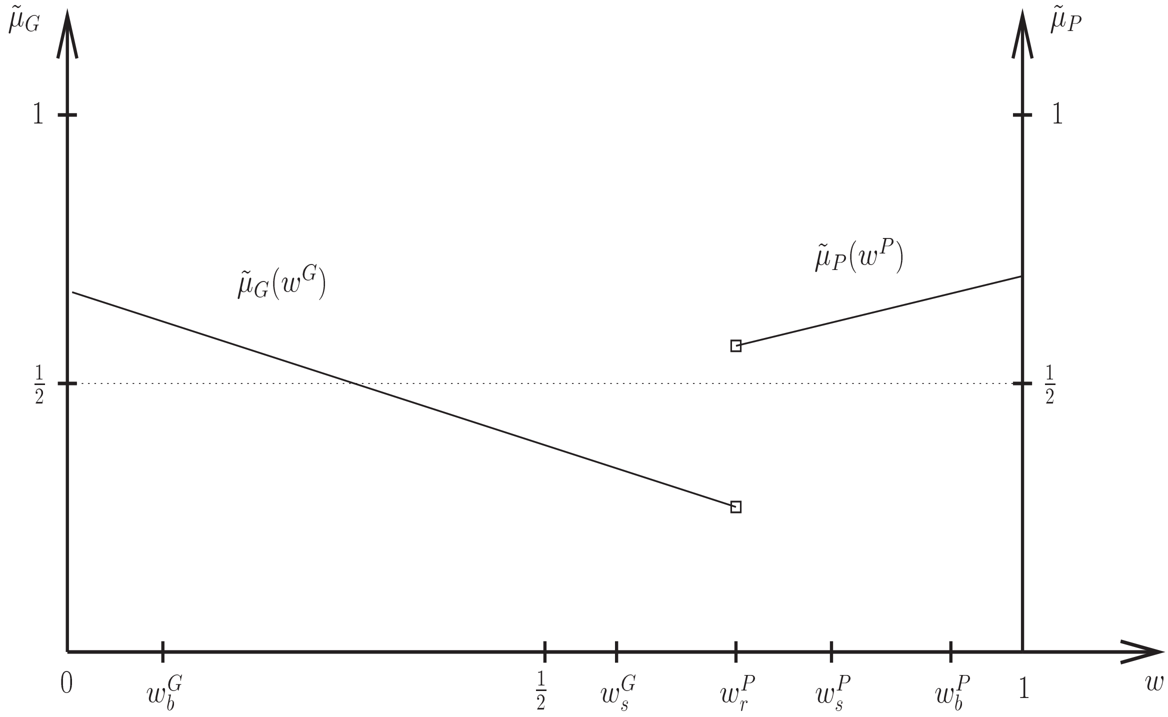
(ii) If $0 < w_r^P < \frac{1}{2}$, we obtain:

$$\tilde{\mu}_G(w^{G*})>\frac{1}{2} \quad \textit{for any} \quad w^{G*}\in[0,w_r^P) \quad \textit{and}$$
$$\tilde{\mu}_P(w^{P*})<\frac{1}{2} \quad \textit{for any} \quad w^{P*}\in(w_r^P,\frac{1}{2}).$$

(iii)

$$\frac{\partial \tilde{\mu}_G}{\partial w^G}(w^G) < 0 \quad \textit{for any} \quad w^G \in [0,1] \setminus w_r^P \quad \textit{and}$$
$$\frac{\partial \tilde{\mu}_P}{\partial w^P}(w^P) > 0 \quad \textit{for any} \quad w^P \in [0,1] \setminus w_r^P.$$

Figure 8.1: Minimum credibility requirements: $\tilde{\mu}_G(w^G)$ for $w^G < w_r^P$, $\tilde{\mu}_P(w^P)$ for $w^P > w_r^P$, and $w_r^P > \frac{1}{2}$.



The proposition reflects the risk aversion of voters: The derivative of $\tilde{\mu}_G(w^G)$ with respect to w^G is negative and the derivative of $\tilde{\mu}_P(w^P)$ with respect to w^P positive. The further the proposal from its alternative, w_r^P, the higher the requirements a proposal must fulfill to be accepted instead of w_r^P. Since a proposal is only approved if $\mu(\theta = v \mid w^v) \geq \tilde{\mu}_v(w^v)$, the large reforms need higher credibility to be accepted than the small reforms.

Since $\frac{1}{2} < w_s^G < w_{sq}$, parts (i) and (iii) of Proposition 9 imply that the small G-reform needs less credibility to be accepted than the small P-reform ($\tilde{\mu}_G(w_s^G) < \frac{1}{2}$ and $\tilde{\mu}_P(w_s^P) > \frac{1}{2}$). This is also due to risk aversion: Since the alternative, w_r^P, is set in accordance with a P-policy, i.e. larger than $\frac{1}{2}$, the gain of implementing a P-reform $w_s^P > w_r^P$ in the case of $\theta = P$ is smaller than the loss of implementing this P-policy in the case of $\theta = G$. This follows directly from the concavity of the utility function. On the other hand, the loss of implementing the small G-reform in the case of $\theta = P$ is smaller than the gain if G was the real state of the world. In part (ii) the proposition shows that the opposite holds if $w_r^P < \frac{1}{2}$. In this case, a small P-reform needs less credibility to be accepted than a small G-reform.

In general, as long as $w_r^P > \frac{1}{2}$, we can say that, due to risk aversion, the loss of a small P-reform relative to the implementation of w_r^P in the case of $\theta = G$ is larger than the gain of implementing this reform in the case of $\theta = P$. Thus, credibility of a small P-reform has to be larger than $\frac{1}{2}$ to be accepted. The opposite holds if $w_r^P < \frac{1}{2}$: P-reforms are less "risky".

The credibility of proposals is derived from M-group's beliefs. If the l-party plays its equilibrium strategy, it is straightforward for M to calculate its beliefs. It is not clear which beliefs M should assign a proposal if l deviates from equilibrium. For a sequential equilibrium, M must have a "theory" about how the mistake could occur. Before we can discuss this theory it will be helpful to define the following terms:

Definition 12 (Equilibrium-, Non-Equilibrium-, and Out-Off-Equilibrium Proposals)

- *An "equilibrium proposal" is an l-type best response proposal in equilibrium even if it is not played with strictly positive probability when l plays its equilibrium strategy.*
- *A "non-equilibrium proposal" is defined accordingly.*
- *An "out-off-equilibrium proposal" is any proposal which is not played with strictly positive probability in equilibrium. This means that an equilibrium proposal can be an out-off-equilibrium proposal, but any non-equilibrium proposal will always be an out-off-equilibrium proposal.*

Concerning the theory M uses to build its beliefs when it observes an out-off-equilibrium proposal, we assume:

Assumption 7

(i) Suppose l plays a non-equilibrium proposal w^v. In this case, deviation probabilities from any equilibrium proposal to w^v are equal.

(ii) Suppose l plays an equilibrium proposal w^{v*} that is out-off-equilibrium. In this case, deviation probabilities from any other equilibrium proposal to w^{v*} are equal. Furthermore, they equal the probability that w^{v*} is not played if it would be played when l deviates from its equilibrium information decision.

(iii) Deviation probabilities from the equilibrium information decision are very small relative to the deviation probabilities from an equilibrium proposal.

The following example illustrates Assumption 7 (i): Suppose α_l^L does not inform and plays in equilibrium w_b^P while α_l^M does inform and plays in equilibrium w_b^G if $\theta = G$, and w_b^P if $\theta = P$. Furthermore, if α_l^L informed it would play w_s^G if $\theta = G$, and w_b^P if $\theta = P$; α_l^M would play w_s^G if it did not inform ($\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w_s^G, w_b^P, w_b^P), \tilde{\sigma}_l^\Pi(\alpha_l^M) = (w_b^G, w_b^P, w_s^G), \sigma_{iL} = 0, \sigma_{iM} = 1$). Suddenly, M observes the non-equilibrium proposal w_s^P. In this case, Assumption 7 (i) tells us that l deviates from w_b^P to w_s^P with the same probability as deviating from w_s^G or w_b^G to w_s^P. We assume that non-equilibrium proposals ("mistakes") and equilibrium proposals are uncorrelated. Consequently, if a mistake occurs, any information that is included in an equilibrium proposal gets lost. For example, if M observes w_b^G, it knows with certainty that the real state of the world is G. If M observes w_s^P, it could stem from any path of the game. Therefore, M will assign the unexpected proposal the a priori belief of $\frac{1}{2}$ to represent the correct state of the world.

Assumptions 7 (ii) and (iii) become relevant when an equilibrium proposal is out-off-equilibrium. That is, this proposal occurs with zero probability if l plays its equilibrium strategy, because it only would be played if l changed its information decision.[3]

Assumption 7 (ii) corresponds to (i) in that we assume that not expected proposals are uncorrelated with the path l has taken until it makes the unexpected proposal (see Appendix B.2 for an example). Concerning Assumption 7 (iii), suppose neither type of l informs but proposes w_s^G. But if a type did inform it would propose w_s^G under $\theta = G$ and w_s^P under $\theta = P$ ($\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w_s^G, w_s^P, w_s^G), \tilde{\sigma}_l^\Pi(\alpha_l^M) = (w_s^G, w_s^P, w_s^G), \sigma_{iL} = 0, \sigma_{iM} = 0$). If this was an equilibrium strategy of l, the w_s^P-proposal would be out-off-equilibrium since information would have probability zero in equilibrium. Now we assume that when M observes w_s^P, it believes that this deviation stems with very high probability from an uninformed type. M believes that the deviation probability from no information to information is so small that M still assigns credibility $\frac{1}{2}$ to this out-off-equilibrium proposal. Clearly, if M considered it very likely that the out-off-equilibrium proposal stemmed from an informed type it would assign a higher credibility to it, since both types propose w_s^P in equilibrium once they have informed. Nevertheless, we consider it plausible that even in this case M is very careful in assigning high credibilities and sticks to its assumption that any information gets lost once l has deviated from its equilibrium behavior.

Overall, this means that the credibility of any out-off-equilibrium proposal is $\frac{1}{2}$. In the next section and in Appendix B.2 we will derive this belief explicitly for two examples.

[3] When a non-equilibrium proposal is played, Assumption 7 (i) obviously leads to a credibility of $\frac{1}{2}$ for this proposal since the information decision does not matter. Furthermore, when an equilibrium proposal is played with positive probability in equilibrium, M assumes that this proposal does not stem from a non-equilibrium information decision.

It turns out that this out-off-equilibrium belief can be justified for all best responses of l.

Proposition 10 (Out-Off-Equilibrium Beliefs)
Suppose that Assumption 7 holds and that deviation probabilities from equilibrium information decisions are "small enough" relative to the deviation probabilities from equilibrium proposals. Thus, the credibility of any out-off-equilibrium proposal is $\frac{1}{2}$.

In Section 10.7, we will discuss the consequences when Assumption 7 is relaxed.

Chapter 9

Equilibria

9.1 Derivation of Sequential Equilibria

9.1.1 Preliminary Considerations

In this section we will derive and discuss some general characteristics of the game's sequential equilibria. They will be useful for the derivation of all possible sequential equilibria in Section 9.2.

First of all note that the assumptions we made concerning out-off-equilibrium beliefs (see previous section, Section 8.3.2) restrict the set of possible equilibria.

Suppose M would play $w^{G,u} = w^{G,o} = w_b^G$, i.e. $\sigma_M(a \mid w_b^G) > 0$ and $\sigma_M(a \mid w_s^G) = 0$. In this case, according to Proposition 8, l would never play w_s^G as best response. But then playing $w^{G,u} = w^{G,o} = w_b^G$ cannot be an equilibrium strategy for M, because the strategy has to be consistent even out-off-equilibrium: If l made a mistake and played w_s^G it would have to be approved by M, since each out-off-equilibrium proposal has credibility $\frac{1}{2}$, whereas the minimum credibility requirement for w_s^G is smaller than $\frac{1}{2}$ (see Proposition 9 (i)).

Lemma 11
In a sequential equilibrium, M will never play $w^{G,u} = w^{G,o} = w_b^G$, i.e. if M accepts the large G-reform it will also accept the small one.

This fact can be intuitively explained by voters' risk aversion: The credibility requirements for a small G-reform are very low (smaller than $\frac{1}{2}$). Consequently, it would in any case be accepted as an out-off-equilibrium proposal. Therefore, for beliefs to be consistent, $\sigma_M(a \mid w_s^G) = 0$ is not possible. If voters are willing to accept a large G-reform they are even more willing to accept a small one.

Additionally, M will always accept one G-proposal with positive probability. To observe this, suppose that $\sigma_M^G = 0$. In this case, $B\Delta\sigma_M$ would be in Areas VI or VII (see Table C.2). In Area VI, the l-party's best responses are such that a G-reform is proposed in equilibrium only if α_l^M has informed and learned that $\theta = G$. This means that M knows with certainty that G is the real state of the world if the equilibrium G-proposal occurs. Therefore, M will approve the proposal. If $w^{G,u} = w_b^G$ and $w^{G,o} = w_s^G$ and the out-off-equilibrium proposal w_s^G occurs, M will accept this proposal as well, because it has credibility $\frac{1}{2}$. Consequently, for Area VI, $\sigma_M^G = 0$ is not possible in equilibrium. In Area VII, the l-party never plays G in equilibrium. Nevertheless, M would approve at least a small G-reform since it would have credibility $\frac{1}{2}$, and thus $\sigma_M^G = 1$ and not $\sigma_M^G = 0$.

Lemma 12
In a sequential equilibrium, M will always play $\sigma_M^G > 0$, i.e. it will always accept at least the small G-reform with positive probability.

Looking in all areas at all possible best responses of l, we recognize that if M accepts both G-reforms, i.e., $w^{G,u} = w_b^G$ and $w^{G,o} = w_s^G$, w_b^G is only proposed if l knows with certainty that the correct state of the world is G. Thus, we can state the following Lemma:

Lemma 13
In a sequential equilibrium, if α_l^M informs with positive probability, and M is willing to accept both G-reforms, the credibility of a w_b^G proposal is 1.

The l-party proposes a policy which is the most unfavorable one for its partisans, only if it knows with certainty that $\theta = G$. This observation is in accordance with intuition: If a party makes a policy which is in opposition to its own partisans, this policy can only be a very credible one. Therefore, the M-group, if it is willing to accept both reforms, will choose $\sigma_M(a \mid w^{G,u}) = 1$.

Furthermore, M will never accept both P-reforms with positive probability. Suppose, M would play $w^{P,u} = w_s^P$ and $w^{P,o} = w_b^P$ with $\sigma_M(a \mid w_s^P) = \sigma_M(a \mid w_b^P) > 0$. In this case, the l-party's best responses in Areas I to VI would be to propose w_b^P. If l made a mistake and proposed w_s^P, M would have to reject the proposal, since out-off-equilibrium credibility is only $\frac{1}{2}$ whereas the minimum credibility of w_s^P to be accepted is larger than $\frac{1}{2}$ (see Proposition 9 (i) and (iv), p. 102). In Area VII, $w^{P,u} = w_s^P$ would not be accepted because M knew that in this case $\theta = G$ and w_s^P would have credibility 0.

Lemma 14
In a sequential equilibrium, M will accept at the most one P-reform with positive probability.

9.1.2 An Example: Sequential Equilibria in Area III

In the following, we will derive exemplarily some sequential equilibria which could be in Area III. All other equilibria can be derived analogously. The results are summarized in Propositions 11 to 15 (Section 9.2), and Table C.4. Whether these equilibria actually exist with respect to parameter constellations will be discussed in a later section. Nevertheless, we will gain important insights into the nature of the game if we first derive all potential equilibria.

Suppose the strategy of M, given by $w^{G,u}$, $w^{G,o}$, σ_M^G, $w^{P,u}$, $w^{P,o}$, and σ_M^P, is such that the l-party's best response is to play $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o})$ and $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$ (Area III a/b). If we want to derive the potential sequential equilibria in this area we have to consider all possible information structures, i.e. all combinations of information decisions α_l^L and α_l^M can make. They can decide to become informed ($\sigma_l(i \mid \alpha_l) = 1$), to stay uninformed ($\sigma_l(i \mid \alpha_l) = 0$) or to be indifferent ($\sigma_l(i \mid \alpha_l) \in [0,1]$).

For ease of presentation, we use the following definition:

Definition 13 (The l-Party's Information Structure)
Suppose M plays strategy σ_l^Π. We define the compound vector $\tilde{\sigma}_l^\mathcal{I}$ as a pair of best response "information states" for both types of l. The first entry is the α_l^L-type's best response information state, the second is that of α_l^M. We use $info$, if the best response is to gather information with certainty, we use $ninfo$ for the uninformed state, and ind, if the l-type is in the state of indifference concerning its information decision. For example, if the α_L^l-type's best response is to stay uninformed, and α_l^M is indifferent, we write:

$$\tilde{\sigma}_l^\mathcal{I} = (ninfo, ind)$$

We call $\tilde{\sigma}_l^\mathcal{I}$ the "information structure" of l. It depends on M's strategy and can be found in Tables C.1 and C.2 (Conditions for $\sigma_{iL} = 1$ and $\sigma_{iM} = 1$).

Note that, if $\sigma_{iM} = 1$, we still say we have an equilibrium with information structure $\tilde{\sigma}_l^\mathcal{I} = (ninfo, ind)$ and not $\tilde{\sigma}_l^\mathcal{I} = (ninfo, info)$. The term information structure is chosen with respect to l-party's best responses given M's strategy. Only in equilibrium, σ_{iM} takes a certain value which can be 1.

To sum up, together with Definition 9 (p. 99), a best response of l can be described by $\tilde{\sigma}_l^\Pi(\alpha_l^L)$, $\tilde{\sigma}_l^\Pi(\alpha_l^M)$, and $\tilde{\sigma}_l^\mathcal{I}$.[1]

In a first step, we assume that $w^{G,u} = w_b^G$ and $w^{G,o} = w_s^G$, and turn to the case where both α_l^L and α_l^M are indifferent as to whether to inform or not to inform, i.e.

[1] Remember that we restrict ourselves to pure strategies with respect to proposals.

$\tilde{\sigma}_l^{\mathcal{I}} = (ind, ind)$.

We use equation (8.5) to derive credibilities for all proposals which are made with positive probability in equilibrium. The proposal $w^{P,o}$ is made from α_l^L if it has not informed, from α_l^L if it has informed and learned that $\theta = P$, and from α_l^M if it has informed and learned that $\theta = P$. Therefore, the credibility of this proposal is:

$$\mu(\theta = P \mid w^{P,o}) = \sum_{(\alpha_l,\imath,\theta=P)\in\mathcal{P}} \mu(\alpha_l, \imath, \theta = P \mid w^{P,o}) =$$
$$\frac{\lambda\cdot\left(\sigma_{iL}\cdot\frac{1}{2}\cdot1+(1-\sigma_{iL})\cdot\frac{1}{2}\cdot1\right)+(1-\lambda)\cdot\left(\sigma_{iM}\cdot\frac{1}{2}\cdot1+(1-\sigma_{iM})\cdot\frac{1}{2}\cdot0\right)}{\lambda\cdot\left(\sigma_{iL}\cdot(\frac{1}{2}\cdot1+\frac{1}{2}\cdot0)+(1-\sigma_{iL})\cdot(\frac{1}{2}\cdot1+\frac{1}{2}\cdot1)\right)+(1-\lambda)\cdot\left(\sigma_{iM}\cdot(\frac{1}{2}\cdot1+\frac{1}{2}\cdot0)+(1-\sigma_{iM})\cdot(\frac{1}{2}\cdot0+\frac{1}{2}\cdot0)\right)} =$$
$$\frac{\lambda + (1-\lambda)\sigma_{iM}}{\lambda(2-\sigma_{iL}) + (1-\lambda)\sigma_{iM}} \in [\frac{1}{2}, 1] \tag{9.1}$$

According to the Zwischenwertsatz [intermediate value theorem], for a given λ, the credibility of a $w^{P,o}$-proposal can take any value between $\frac{1}{2}$ ($\sigma_{iL} = \sigma_{iM} = 0$) and 1 ($\sigma_{iL} = \sigma_{iM} = 1$). If the l-party's best responses are those of Area III, the credibility cannot be smaller than the a priori credibility of $\frac{1}{2}$, because l informs with a certain probability and it will always propose the correct state of the world if it is informed. It will never play $w^{P,o}$ if it learns that $\theta = G$, i.e., it will never "lie". Only this behavior could reduce the credibility of the $w^{P,o}$-proposal below the a priori credibility of $\frac{1}{2}$.

Analogously, we obtain the credibility of a $w^{G,o}$-proposal:

$$\mu(\theta = G \mid w^{G,o}) = \frac{\lambda\sigma_{iL} + (1-\lambda)(1-\sigma_{iM})}{\lambda\sigma_{iL} + 2(1-\lambda)(1-\sigma_{iM})} \in [\frac{1}{2}, 1] \tag{9.2}$$

We assumed that $w^{G,u} = w_b^G$ and $w^{G,o} = w_s^G$. Therefore, the credibility of the $w^{G,u} = w_b^G$ proposal is 1, since this proposal is only made up of α_l^M if it has learned that $\theta = G$ (see Lemma 13).

$$\mu(\theta = G \mid w^{G,u}) = 1 \tag{9.3}$$

Furthermore, the derivation of equilibria also requires to determine out-off-equilibrium beliefs. Proposition 10 states that credibility is $\frac{1}{2}$ for any out-off-equilibrium proposal. Now we will verify this statement for a non-equilibrium $w^P \neq w^{P,u} = w^{P,o}$.[2][3] In a sequential equilibrium, out-off-equilibrium beliefs have to be derived from a sequence of totally mixed strategies that converge to the equilibrium strategy. This sequence can be any sequence of strategies that converges. We define the following one:

[2]For the definition of a non-equilibrium proposal, see Definition 12, p. 104.

[3]According to Lemma 14, there is only one P-proposal in equilibrium that is accepted with positive probability. Thus, we have $w^{P,u} = w^{P,o}$.

Let $\{\sigma_{iL}^k\}$ and $\{\sigma_{iM}^k\}$ be sequences of information probabilities which converge to equilibrium probabilities σ_{iL}^* and σ_{iM}^*:

$$\begin{aligned}\lim_{k\to\infty}\sigma_{iL}^k &= \sigma_{iL}^* \quad \text{and}\\ \lim_{k\to\infty}\sigma_{iM}^k &= \sigma_{iM}^*.\end{aligned}$$

Furthermore, let $\{\psi_P^k\}$ be the sequence of deviation probabilities from $w^{P,u} = w^{P,o}$ to w^P and let $\{\psi_G^k\}$ be the sequence of deviation probabilities from $w^{G,u}$ and $w^{G,o}$ to w^P. Because the sequence of strategies has to converge to the equilibrium strategy and $\{\psi_P^k\}$ and $\{\psi_G^k\}$ are deviation probabilities it must hold that:

$$\begin{aligned}\lim_{k\to\infty}\psi_G^k &= 0 \quad \text{and}\\ \lim_{k\to\infty}\psi_P^k &= 0.\end{aligned}$$

Now, we can calculate the credibility of a non-equilibrium P-proposal:

$$\mu(\theta = P \mid w^P) =$$
$$\lim_{k\to\infty}\frac{\lambda\left(\sigma_{iL}^k\frac{1}{2}\psi_P^k + (1-\sigma_{iL}^k)\frac{1}{2}\psi_P^k\right) + (1-\lambda)\left(\sigma_{iM}^k\frac{1}{2}\psi_P^k + (1-\sigma_{iM}^k)\frac{1}{2}\psi_G^k\right)}{\lambda\left(\sigma_{iL}^k(\frac{1}{2}\psi_G^k + \frac{1}{2}\psi_P^k) + (1-\sigma_{iL}^k)\psi_P^k\right) + (1-\lambda)\left(\sigma_{iM}^k(\frac{1}{2}\psi_G^k + \frac{1}{2}\psi_P^k) + (1-\sigma_{iM}^k)\psi_G^k\right)}$$

Because we assume that deviation probabilities from equilibrium G- and P-proposals are all equal ($\psi_G^k = \psi_P^k$, Assumption 7 (i), p. 104), by dividing numerator and denominator by ψ_G^k or ψ_P^k we obtain:

$$\mu(\theta = P \mid w^P) =$$
$$\lim_{k\to\infty}\frac{\lambda\left(\sigma_{iL}^k\frac{1}{2} + (1-\sigma_{iL}^k)\frac{1}{2}\right) + (1-\lambda)\left(\sigma_{iM}^k\frac{1}{2} + (1-\sigma_{iM}^k)\frac{1}{2}\right)}{\lambda\left(\sigma_{iL}^k + (1-\sigma_{iL}^k)\right) + (1-\lambda)\left(\sigma_{iM}^k + (1-\sigma_{iM}^k)\right)} = \frac{1}{2}$$

This is a general result that we obtain for any out-off-equilibrium belief. In the appendix we make general statements and give an example for the case where an equilibrium proposal is out-off-equilibrium.

After deriving beliefs, we are able to determine potential sequential equilibria with $\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o})$, $\tilde{\sigma}_l^{\Pi}(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$, and $\tilde{\sigma}_l^{\mathcal{I}} = (ind, ind)$.

If $w^{G,u} = w_b^G$, and $w^{G,o} = w_s^G$, the credibility of the $w^{G,o} = w_s^G$ proposal is at least $\frac{1}{2}$ (see equation (9.2)). Because we assume that $w_s^G > \frac{1}{2}$, Proposition 9 (i) implies that the minimum credibility requirement to approve this proposal is less than $\frac{1}{2}$ (see p. 102). Therefore, M will accept w_s^G with certainty. The same holds for the large G-reform: M knows with certainty that the real state of the world is G, if l proposes w_b^G. Its credibility is 1 (see equation (9.3)). Consequently, M will accept any G-reform with $\sigma_M^G = 1$.

So far we have assumed that $w^{G,u} \neq w^{G,o}$. In a next step, we will analyze whether $w^{G,u} = w^{G,o} = w_s^G$ can also be an equilibrium.[4] In this case, the credibility of proposing the small G-reform is still at least $\frac{1}{2}$ because with information, l will always propose the correct state of the world (does not lie). Therefore, M will approve the small reform with $\sigma_M^G = 1$. On the other hand, proposing the large G-reform is out-off-equilibrium. Therefore, it has credibility $\frac{1}{2}$. The strategy to reject the large G-reform is consistent with beliefs only if $\tilde{\mu}_G(w_b^G) \geq \frac{1}{2}$. If $\tilde{\mu}_G(w_b^G) < \frac{1}{2}$, M would have to approve both G-reforms and hence, $w^{G,u} = w^{G,o} = w_s^G$ with $\sigma_M^G = 1$ would not be an equilibrium.

In summary, we have to distinguish two cases. Firstly, if the large G-reform is "very large", i.e. $\tilde{\mu}_G(w_b^G) \geq \frac{1}{2}$, there are two possibilities in equilibrium: $w^{G,u} = w_{e,b}^G$ and $w^{G,o} = w_s^G$ with $\sigma_M^G = 1$ or $w^{G,u} = w^{G,o} = w_s^G$ with $\sigma_M^G = 1$. Secondly, if the large G-reform is "moderate", i.e. $\tilde{\mu}_G(w_b^G) < \frac{1}{2}$, then there is only one possibility: $w^{G,u} = w_{e,b}^G$ and $w^{G,o} = w_s^G$ with $\sigma_M^G = 1$.

According to Lemma 14, M will accept at the most one P-proposal. If $\mu(\theta = P \mid w^{P,o}) > \tilde{\mu}_P(w^{P,o})$, M will accept the proposal with probability 1. In this case, the l-party's best responses are those of Area VI, because σ_M^G is also 1 and thus $B\Delta\sigma_M = 0$. Hence, there is no equilibrium of this kind in Area III. If $\mu(\theta = P \mid w^{P,o}) < \tilde{\mu}_P(w^{P,o})$, M will reject the proposal, i.e. $\sigma_M^P = 0$. Again, there cannot be an equilibrium of this kind in Area III, since we assume that $B > \Delta c \max_{w^v} \Delta w^v$ (Assumption 6). Therefore, $B\Delta\sigma_M = B \cdot (1-0)$ is also larger than $\Delta c \max_{w^v} \Delta w^v$ whereas an equilibrium in Area III would require that $B\Delta\sigma_M = B \cdot (1-0)$ is equal or smaller than $(1-\alpha_l^L)\Delta c \Sigma_M^o = (1-\alpha_l^L)\Delta c \Delta w^{G,o}$. In the case of $\mu(\theta = P \mid w^{P,o}) = \tilde{\mu}_P(w^{P,o})$, M is indifferent, i.e. $\sigma_M^P \in [0,1]$. If there is a $\sigma_M^P \in (0,1)$ which fulfills the information indifference conditions of Area III for both l-types [5], we have found a σ_M^P constituting a potential sequential equilibrium in this area. Note that, given the information indifference conditions can be fulfilled, a sequential equilibrium of this kind always exists because there is always a combination $(\sigma_{iL}, \sigma_{iM})$ of information probabilities that satisfies $\mu(\theta = P \mid w^{P,o}) = \tilde{\mu}_P(w^{P,o})$ for any value of $w^{P,o} \in (w_r^P, 1]$(see equation (9.1)).

Now, we are able to summarize our considerations. A potential sequential equilibrium in Area III where both types of l are indifferent with respect to their information decisions can be characterized by the following strategies: The l-party makes proposals according to its best responses in Area III, i.e $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o})$ and $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$. The information probabilities $(\sigma_{iL}, \sigma_{iM})$ of the two l-types are given by the minimum credibility requirement of the single P-proposal, M is willing to accept. The M-group approves this P-proposal with probability $\sigma_M^P \in (0,1)$

[4] Remember that $w^{G,u} = w^{G,o} = w_b^G$ can never be an equilibrium (Lemma 11, p. 107).

[5] These conditions are: $\frac{1}{2}B\Delta\sigma_M - k = (\frac{1}{2} - \alpha_l^L)\Delta c \Sigma_M^o$ and $\frac{1}{2}B\Delta\sigma_M + k = \frac{1}{2}\sigma_M^P \Delta c \Delta w^{P,o} + \sigma_M^G \Delta c \left[\left(\alpha_l^M - \frac{1}{2}\right)\Delta w^{G,u} + \left(1 - \alpha_l^M\right)\Delta w^{G,o}\right]$ (see Table C.1).

which is determined by the information conditions of both l-types (see Table C.1). If a G-proposal is made, it is accepted with certainty, i.e. $\sigma_M^G = 1$. M approves either both possible G-reforms or just the small G-reform. The last strategy is only possible, if the large G-reform is "too" large. The credibility of the small G-proposal is always at least $\frac{1}{2}$, credibilities of out-off-equilibrium proposals are always exactly $\frac{1}{2}$.

The next information structure we want to analyze in Area III is $\tilde{\sigma}_l^{\mathcal{I}} = (ind, info)$. We can use equation (9.1) with $\sigma_{iM} = 1$ to determine the credibility of the $w^{P,o}$-proposal:

$$\mu(\theta = P \mid w^{P,o}) = \frac{1}{1 + \lambda(1 - \sigma_{iL})} \in [\frac{1}{1+\lambda}, 1] \tag{9.4}$$

If we choose σ_{iL} accordingly, the credibility of the $w^{P,o}$-proposal can take any value between $\frac{1}{1+\lambda}$ and 1. A value smaller than $\frac{1}{1+\lambda}$ is not possible.

Obviously, given the information structure $(ind, info)$, and $\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o})$, $\tilde{\sigma}_l^{\Pi}(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$, both $w^{G,o}$ and $w^{G,u}$ are only proposed, if l knows with certainty that $\theta = G$. Hence, we obtain:

$$\mu(\theta = G \mid w^{G,o}) = \mu(\theta = G \mid w^{G,u}) = 1.$$

There is no difference between the case where $w^{G,u} \neq w^{G,o}$ and $w^{G,u} = w^{G,o} = w_s^G$.

As always, if l makes the out-off-equilibrium P-proposal, the credibility of this proposal is:

$$\mu(\theta = P \mid w^P) = \frac{1}{2}.$$

In a potential equilibrium of Area III, and with $\tilde{\sigma}_l^{\mathcal{I}} = (ind, info)$, M takes the same actions concerning G-proposals as above with $\tilde{\sigma}_l^{\mathcal{I}} = (ind, ind)$. The same holds for P-proposals except for two differences. Firstly, $\sigma_M^P \in (0,1)$ is such that α_l^M is not indifferent concerning its information decision (see Table C.1: $\frac{1}{2}B\Delta\sigma_M + k < \frac{1}{2}\sigma_M^P \Delta c \Delta w^{P,o} + \sigma_M^G \Delta c \left[\left(\alpha_l^M - \frac{1}{2}\right)\Delta w^{G,u} + \left(1 - \alpha_l^M\right)\Delta w^{G,o}\right]$). Secondly, not all P-proposals with $w^{P,o} \in (w_r^P, 1]$ can constitute an equilibrium of this kind. The $w^{P,o}$-proposal has to be large enough, i.e. this equilibrium only exists if $\tilde{\mu}_P(w^{P,o}) \geq \frac{1}{1+\lambda}$. On the other hand, if the latter condition holds, there will always be a value of σ_{iL} that satisfies $\mu(\theta = P \mid w^{P,o}) = \tilde{\mu}_P(w^{P,o})$ (see equation (9.4)).

There will not be an equilibrium, if credibility of the P-proposal is too large, i.e $\mu(\theta = P \mid w^{P,o}) > \tilde{\mu}_P(1)$. In this case, M would accept the P-proposal with certainty, and l's best responses would not be those of Area III. Instead, l would respond according to Area VI. In the case of $\sigma_M^P = 1$, the α_l^L-type would lose any incentive to gather information. It would never inform and always propose the best policy for its partisans, i.e. $w^{P,o}$. In particular, there will not be an equilibrium in Area III with information structure $(ind, info)$ if $\sigma_{iL} = 1$ since then, both types would inform with certainty and the P-proposal would have credibility 1.

For $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, ind)$ in Area III, we obtain:

$$\mu(\theta = P \mid w^{P,o}) = \frac{\lambda + (1-\lambda)\sigma_{iM}}{2\lambda + (1-\lambda)\sigma_{iM}} \in [\frac{1}{2}, \frac{1}{1+\lambda}]$$

In this case, credibility can take any value between $\frac{1}{2}$ ($\sigma_{iM} = 0$) and $\frac{1}{1+\lambda}$ ($\sigma_{iM} = 1$), but never larger than $\frac{1}{1+\lambda}$. Therefore, an equilibrium in this area can only exist if at least one P-reform is not too large, i.e. $\tilde{\mu}_P(w^{P,o}) \leq \frac{1}{1+\lambda}$.

In the case of $w^{G,u} \neq w^{G,o}$, i.e. $w^{G,u} = w_b^G$ and $w^{G,o} = w_s^G$, beliefs are:

$$\mu(\theta = G \mid w^{G,o}) = \frac{1}{2}$$
$$\mu(\theta = G \mid w^{G,u}) = 1$$

On the other hand, if $w^{G,u} = w^{G,o} = w_s^G$, credibility of the $w^{G,o}$-proposal can be higher than $\frac{1}{2}$, because it represents with probability σ_{iM} the correct state of the world:

$$\mu(\theta = G \mid w^{G,o}) \geq \frac{1}{2}$$

Therefore, in a potential equilibrium with $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, ind)$, M takes the same actions concerning G-proposals as above ($\tilde{\sigma}_l^{\mathcal{I}} = (ind, ind)$, and $\tilde{\sigma}_l^{\mathcal{I}} = (ind, info)$).

Finally, we discuss potential equilibria in Area III with information structure $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, ninfo)$. In this case, we clearly obtain the following beliefs:

$$\mu(\theta = P \mid w^{P,o}) = \mu(\theta = G \mid w^{G,o}) = \frac{1}{2}$$

According to Proposition 9, (i) and (iv), the minimum credibility requirements for P-proposals are larger than $\frac{1}{2}$ (see p. 102). Thus, M will reject any P-proposal, i.e. $\sigma_M^P = 0$. Hence, there is no equilibrium with $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, ninfo)$, since benefits from holding office are too large (Assumption 6, p. 95). With $\sigma_M^P = 0$, $B\Delta\sigma_M$ never lies in Area III.

9.2 Potential Sequential Equilibria

In this section, we will name and discuss the sequential equilibria of the voting game. To be precise, we will use the term "potential sequential equilibria" for sequential equilibria that may exist on the basis of strategic considerations like those that we made in the last section. Whether these equilibria actually exist, depends on parameter constellations. These are l's conditions for the named best response proposals and conditions for its best response information states (Tables C.1 and C.2). Furthermore, the existence of equilibria depends on the relationship between M-group's beliefs and credibility requirements for proposals.

The problem of existence will be explicitly discussed in Section 10.1 "Existence".

We will summarize the general characteristics of sequential equilibria in the next section, Section 9.3 "Summary: General Characteristics of Sequential Equilibria". Therefore, the reader may skip the discussion of potential sequential equilibria in the current section. Nevertheless, we will frequently refer to the named equilibrium strategies in all subsequent discussions.

We obtain all potential sequential equilibria by considering the possible best response proposals according to Tables C.1 and C.2 for given σ_M^G, σ_M^P, $w^{G,u}$, $w^{G,o}$, and $w^{P,o}$.[6] For each area, we have to consider 9 possible information structures, i.e. 9 combinations of information states $info$, ind, and $ninfo$. Thereafter, given these best response proposals and information structures of l, we derive credibilities (beliefs) for proposals and derive the corresponding best responses of M, which - in turn - have to be consistent with the originally given σ_M^G, σ_M^P, $w^{G,u}$, $w^{G,o}$, and $w^{P,o}$.

All potential sequential equilibria of the game can be derived analogously to those we have derived above. In the following, we name the equilibrium strategies and introduce GI, GII, PI, PII, and PIII to denote the different types of behavior for M in equilibrium.

9.2.1 Discussion of Area-I-Equilibria

Proposition 11

The following strategies constitute potential sequential equilibria in Area I:

$\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{G,o}, w^{G,o}, w^{G,o})$, $\tilde{\sigma}_l^{\Pi}(\alpha_l^M) = (w^{G,u}, w^{G,o}, w^{G,o})$

α_l^L *will never inform;* α_l^M *will inform if* $\alpha_l^M > \frac{1}{2} + \frac{k}{\sigma_M^G \Delta c(w^{G,o} - w^{G,u})}$

- $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, ninfo)$:
  - *If* $\tilde{\mu}_G(w_b^G) \leq \frac{1}{2}$:

    GI: $w^{G,u} = w_b^G$ *and* $w^{G,o} = w_s^G$ *with* $\sigma_M^G = 1$

    $\mu^*(\theta = G \mid w_b^G) = \frac{1}{2}$, $\mu^*(\theta = G \mid w_s^G) = \frac{1}{2}$

    PI: $w^{P,u} = w_s^P$ *and* $w^{P,o} = w_b^P$ *with* $\sigma_M^P = 0$

    $\mu^*(\theta = P \mid w_s^P) = \frac{1}{2}$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{2}$

[6] Remember that, according to Lemma 14, M will accept at the most one P-reform. Therefore, we only have to consider the case where $w^{P,u} = w^{P,o}$.

– *If* $\tilde{\mu}_G(w_b^G) \geq \frac{1}{2}$*:*

GII: $w^{G,u} = w^{G,o} = w_s^G$ *with* $\sigma_M^G = 1$

$\mu^*(\theta = G \mid w_b^G) = \frac{1}{2}$, $\mu^*(\theta = G \mid w_s^G) = \frac{1}{2}$

PI: $w^{P,u} = w_s^P$ *and* $w^{P,o} = w_b^P$ *with* $\sigma_M^P = 0$

$\mu^*(\theta = P \mid w_s^P) = \frac{1}{2}$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{2}$

- $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, ind)$*:*

– *For any* $w_s^G > \frac{1}{2}$*:*

GI: $w^{G,u} = w_b^G$ *and* $w^{G,o} = w_s^G$ *with* $\sigma_M^G = 1$

$\mu^*(\theta = G \mid w_b^G) = 1$, $\tilde{\mu}_G(w_s^G) \leq \mu^*(\theta = G \mid w_s^G) = \frac{1-(1-\lambda)\sigma_{iM}}{2-(1-\lambda)\sigma_{iM}} \in [\frac{\lambda}{1+\lambda}, \frac{1}{2}]$

PI: $w^{P,u} = w_s^P$ *and* $w^{P,o} = w_b^P$ *with* $\sigma_M^P = 0$

$\mu^*(\theta = P \mid w_s^P) = \frac{1}{2}$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{2}$

- $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, info)$*:*

– *If* $\tilde{\mu}_G(w_s^G) \leq \frac{\lambda}{1+\lambda}$*:*

GI: $w^{G,u} = w_b^G$ *and* $w^{G,o} = w_s^G$ *with* $\sigma_M^G = 1$

$\mu^*(\theta = G \mid w_b^G) = 1$, $\mu^*(\theta = G \mid w_s^G) = \frac{\lambda}{1+\lambda} \leq \frac{1}{2}$

PI: $w^{P,u} = w_s^P$ *and* $w^{P,o} = w_b^P$ *with* $\sigma_M^P = 0$

$\mu^*(\theta = P \mid w_s^P) = \frac{1}{2}$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{2}$

Firstly, we look at sequential equilibria with information structure $(ninfo, ninfo)$. If $\tilde{\mu}_G(w_b^G) \leq \frac{1}{2}$, and M approves both the small and the large G-reform with certainty, neither type of l will inform in the case of $\alpha_l^M < \frac{1}{2} + \frac{k}{\Delta c(w^{G,o} - w^{G,u})}$ and $\sigma_M^P = 0$. Behavior GI with $\sigma_M^G = 1$ and PI with $\sigma_M^P = 0$ constitute an equilibrium strategy of M given l plays the corresponding strategies. The equilibrium beliefs are $\mu^*(\theta = G \mid w_b^G) = \frac{1}{2}$, $\mu^*(\theta = G \mid w_s^G) = \frac{1}{2}$, $\mu^*(\theta = P \mid w_s^P) = \frac{1}{2}$, and $\mu^*(\theta = P \mid w_b^P) = \frac{1}{2}$. Both, α_l^L and α_l^M will propose $w^{G,o}$ in equilibrium. If l makes a "mistake", and wants to implement $w^{G,u} = w_b^G$, which is out-off-equilibrium, this proposal is also approved since it is not too risky, i.e. $\tilde{\mu}_G(w_b^G) \leq \frac{1}{2}$, and the large G-reform is not too large. If the large G-reform is too large, i.e. $\tilde{\mu}_G(w_b^G) > \frac{1}{2}$, M is only willing to accept the small G-reform. Then, GII with $\sigma_M^G = 1$ and PI with $\sigma_M^P = 0$ constitute equilibrium strategies for M. Note that, in this case $w^{G,u} = w^{G,o}$ and thus the information condition for l is not fulfilled $(\frac{1}{2} + \frac{k}{\sigma_M^G \Delta c(w^{G,o} - w^{G,u})} \to \infty)$. The reason is that l always proposes w_s^G, and therefore has no incentives to gather information.

A sequential equilibrium where α_l^M informs is only possible if $\tilde{\mu}_G(w_s^G) \leq \frac{\lambda}{1+\lambda}$. If the small G-reform is too large, i.e. $\tilde{\mu}_G(w_s^G) > \frac{\lambda}{1+\lambda}$, the small G-reform becomes too risky for voters. The reason is that α_l^M proposes a G-reform even if it knows that $\theta = P$, i.e., this type "lies". Therefore, such an equilibrium only exists if the occurrence probability λ for the α_l^L-type is high enough. This type does actually not inform but at the same time it never "lies" unlike α_l^M.

Furthermore, if $\tilde{\mu}_G(w_s^G) > \frac{\lambda}{1+\lambda}$, $\tilde{\mu}_G(w_b^G) < \frac{1}{2}$, and $\alpha_l^M > \frac{1}{2} + \frac{k}{\sigma_M^G \Delta c\left(w_s^G - w_b^G\right)}$, then σ_M^G must be at least larger than zero and no sequential equilibrium in Area I will exist: Suppose M would play $w^{G,u} = w_b^G$, $w^{G,o} = w_s^G$ with $0 < \sigma_M^G \leq 1$. In this case, since $\alpha_l^M > \frac{1}{2} + \frac{k}{\sigma_M^G \Delta c\left(w_s^G - w_b^G\right)}$, α_l^M would inform and if l played w_s^G, credibility of this proposal would be $\frac{\lambda}{1+\lambda}$. Therefore, this proposal would have to be rejected since minimum credibility requirement $\tilde{\mu}_G(w_s^G)$ is larger than $\frac{\lambda}{1+\lambda}$. Hence, playing $\sigma_M(a \mid w_s^G) = \sigma_M^G > 0$ cannot be an equilibrium strategy for M. On the other hand, if M played $w^{G,u} = w^{G,o} = w_s^G$, l would never inform and always propose w_s^G. But if l made the out-off-equilibrium proposal w_b^G, it would have to be accepted by M since $\tilde{\mu}_G(w_b^G) < \frac{1}{2}$. Therefore, playing $\sigma_M(a \mid w_b^G) = 0$ cannot be an equilibrium either. Eventually, according to Lemma 11 (p. 107), we can exclude $w^{G,u} = w^{G,o} = w_b^G$ to constitute an equilibrium. In summary, we can conclude that no equilibrium in Area I will exist if $\tilde{\mu}_G(w_s^G) > \frac{\lambda}{1+\lambda}$, $\tilde{\mu}_G(w_b^G) < \frac{1}{2}$, and $\alpha_l^M > \frac{1}{2} + \frac{k}{\Delta c\left(w_s^G - w_b^G\right)}$. The reason is that, according to Proposition 11, any potential equilibrium in this area has to be an equilibrium with $\sigma_M^G = 1$.

Note that, in any potential sequential equilibrium of Area I at least one G-proposal is approved with certainty, i.e. $\sigma_M^G = 1$, and no P-proposal is accepted, i.e. $\sigma_M^P = 0$. The reason is that any P-proposal is out-off-equilibrium, and thus only has credibility $\frac{1}{2}$, whereas even the small P-reforms require a higher credibility to be accepted.

9.2.2 Discussion of Area-II-Equilibria

In the next step, we discuss potential sequential equilibria in Area II. Best response proposals there are $\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o})$ and $\tilde{\sigma}_l^{\Pi}(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$. Suppose neither type informs. In this case, both types propose $w^{G,o}$. This proposal has credibility $\frac{1}{2}$, and thus $\sigma_M^G = 1$. A P-proposal is out-off-equilibrium and also has credibility $\frac{1}{2}$. Therefore, it is rejected by M, i.e. $\sigma_M^P = 0$. In this case, $B\Delta\sigma_M = B$ and $\Delta c \Sigma_M^o = \Delta c \Delta w^{G,o}$. According to Assumption 6 (p. 95), we know that $B > \Delta c \Delta w^{G,o}$, and thus an equilibrium with $\sigma_M^G = 1$ and $\sigma_M^P = 0$ cannot lie in Area II, where $B\Delta\sigma_M \leq \Delta c \Sigma_M^o$. Furthermore, suppose one or both types of l inform with positive probability. Thus, the credibility of the $w^{P,o}$-proposal is 1 and M will approve this proposal with certainty. In this case, $\Delta\sigma_M \leq 0$, and l's best responses to this behavior of M would not be that of Area II. In fact, if $\sigma_M^P \geq \sigma_M^G$, at least the α_l^L-type never has an incentive to propose G even if it knew that $\theta = P$. To sum up, there is no sequential equilibrium in Area II.

Proposition 12
There are no potential sequential equilibria in Area II, i.e. there are no equilibria where the l-party proposes $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o})$ *and* $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$.

9.2.3 Discussion of Equilibria in Areas III to V

The characteristics of sequential equilibria in Areas III, IVa, IVb, and V are summarized in the following proposition:

Proposition 13
The following strategies constitute potential sequential equilibria in Areas III, IVa, IVb, and V:

The following proposals $\tilde{\sigma}_l^\Pi(\alpha_l^L)$, $\tilde{\sigma}_l^\Pi(\alpha_l^M)$ *and information structures* $\tilde{\sigma}_l^\mathcal{I}$ *are possible:*

- *Area III:* $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o})$, $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$

  $(ninfo, info), (ninfo, ind), (ind, info), (ind, ind)$

- *Area IVa:* $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o})$, $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{P,o})$

  $(ninfo, info), (ninfo, ind), (ind, info)$

- *Area IVb:* $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{P,o}, w^{P,o}, w^{P,o})$, $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$

  $(ninfo, info), (ninfo, ind)$

- *Area V:* $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{P,o}, w^{P,o}, w^{P,o})$, $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{P,o})$

  $(ninfo, info), (ninfo, ind)$

Information conditions are named in Table C.1.

The following strategies of M are conceivable:

- *For G-proposals and if α_l^M informs with strictly positive probability:*
  - *For any w_b^G:*
    GI: $w^{G,u} = w_b^G$ *and* $w^{G,o} = w_s^G$ *with* $\sigma_M^G = 1$

$\mu^*(\theta = G \mid w_b^G) = 1$, $\mu^*(\theta = G \mid w_s^G) \geq \frac{1}{2}$

- *If* $\tilde{\mu}_G(w_b^G) \geq \frac{1}{2}$*:*

  GII: $w^{G,u} = w^{G,o} = w_s^G$ *with* $\sigma_M^G = 1$

  $\mu^*(\theta = G \mid w_b^G) = \frac{1}{2}$, $\mu^*(\theta = G \mid w_s^G) \geq \frac{1}{2}$

- *For G-proposals and if* α_l^M *does not inform. This is only possible for III* (ind, ind)*:*

  - *If* $\tilde{\mu}_G(w_b^G) \geq \frac{1}{2}$*:*

    GII: $w^{G,u} = w^{G,o} = w_s^G$ *with* $\sigma_M^G = 1$

    $\mu^*(\theta = G \mid w_b^G) = \frac{1}{2}$, $\mu^*(\theta = G \mid w_s^G) \geq \frac{1}{2}$

- *For P-proposals:*

  - *PII:* $w^{P,u} = w^{P,o} = w_s^P$ *with* $\sigma_M^P \in (0,1)$

    $\mu^*(\theta = P \mid w_s^P) = \tilde{\mu}_P(w_s^P)$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{2}$

  - *PIII:* $w^{P,u} = w^{P,o} = w_b^P$ *with* $\sigma_M^P \in (0,1)$

    $\mu^*(\theta = P \mid w_s^P) = \frac{1}{2}$, $\mu^*(\theta = P \mid w_b^P) = \tilde{\mu}_P(w_b^P)$

The exact values of credibilities can be found in Table C.3.

In all potential sequential equilibria of Areas III to V the strategies of the l-party imply information probabilities $(\sigma_{iL}, \sigma_{iM})$ *that generate beliefs* $\mu(\theta = P \mid w^{P,o})$ *with* $\mu(\theta = P \mid w^{P,o}) = \tilde{\mu}_P(w^{P,o})$.

From the table of credibilities (Table C.3), we can conclude:

- *Potential equilibria in Areas III, IVa, IVb, and V with* $(ninfo, ind)$ *exist if* $\tilde{\mu}_P(w^{P,o}) \leq \frac{1}{1+\lambda}$.
- *Potential equilibria in Areas III and IVa with* $(ind, info)$ *exist if* $\tilde{\mu}_P(w^{P,o}) \geq \frac{1}{1+\lambda}$.
- *Potential equilibria in Areas III, IVa, IVb, and V with* $(ninfo, info)$ *exist if* $\tilde{\mu}_P(w^{P,o}) = \frac{1}{1+\lambda}$.
- *Potential equilibria in Area III with* (ind, ind) *always exist with respect to credibility requirements.*

Firstly, we analyze which information structures are possible in Areas III to V.

There is no sequential equilibrium with $(ninfo, ninfo)$. The reason is that in such a case credibility of any proposal would be $\frac{1}{2}$. Therefore, $\sigma_M^G = 1$, whereas no P-proposal would be accepted, and hence $\sigma_M^P = 0$. According to Assumption 6(p. 95), no such equilibrium can exist in Areas III to V.

Furthermore, there is no sequential equilibrium with $(info, info)$. If both types of l inform and make proposals according to Areas III and IVa, each equilibrium proposal would have credibility 1. Therefore, $\sigma_M^P = 1$, and best responses of l would not be those of Area III and IVa, e.g. the α_l^L-type would lose any incentive to propose G with information. The latter is the case in Areas IVb and V anyway. In these areas, α_l^L always proposes $w^{P,o}$ and thus, this type will never inform. The reason is that in these areas the value of σ_M^P which constitutes an equilibrium is relatively high (Areas IVb and V versus Area III) or α_l^L is relatively small (Area IVb versus Area IVa). Therefore, the α_l^L-type's incentives to propose G because of reelection ($\sigma_M^G = 1$) are lower. They are so low, that the only possible information structures of Areas IVb and V are those where α_l^L does not inform.

In Area III, we can also exclude equilibria with information structure $(info, ind)$ and $(info, ninfo)$. In these cases, the equilibrium P-proposal would have credibility 1 and responses of Area III are no more best responses. Furthermore, we can also exclude information structure $(ind, ninfo)$. Information structure (ind, ind) only exists if $B\Delta\sigma_M = (1-\alpha_l^L)\Delta c\Sigma_M^o$ and $w^{G,u} = w^{G,o}$. This and the non-existence of $(ind, ninfo)$ is proved in Appendix B.2.

In Area IVa, the information condition for α_l^L is $\frac{1}{2}B\Delta\sigma_M - k > (\frac{1}{2}-\alpha_l^L)\Delta c\Sigma_M^o$, and α_l^M informs with certainty if $\frac{1}{2}B\Delta\sigma_M - k > \left(\frac{1}{2} - \alpha_l^M\right)\Delta c\left(\sigma_M^G \Delta w^{G,u} + \sigma_M^P \Delta w^{P,o}\right)$. Since $\alpha_l^L \leq \frac{1}{2}$, the right hand side of its information condition implies that the α_l^L-type only informs, or is indifferent concerning its information decision, if $\frac{1}{2}B\Delta\sigma_M - k \geq 0$. On the other hand, because $\alpha_l^M > \frac{1}{2}$, the right hand side of α_l^M's information condition implies that $\frac{1}{2}B\Delta\sigma_M - k < 0$, if α_l^M is indifferent or does not inform. Thus, we can exclude for IVa information structures with $(info, ind)$, $(info, ninfo)$, (ind, ind), and $(ind, ninfo)$. In Area IVa, σ_M^P is high and thus, α_l^L has less incentives to inform. Therefore, if α_l^L informed or was indifferent, α_l^M would inform all the more. Hence, the latter information structures are not possible.

All potential sequential equilibria in Proposition 13 are characterized by $\sigma_M^G = 1$ and $\sigma_M^P \in (0,1)$. Except in the single case where α_l^M does not inform, it is always possible that M accepts both G-reforms. If M is willing to do so and does observe $w^{G,u} = w_b^G$, i.e. l proposes the large G-reform, M knows for sure that this reform represents the correct state of the world. In equilibrium, this proposal can only stem from an informed α_l^M-type which will never "lie" in Areas III to V, i.e. which will never propose the incorrect state of the world if it is informed about the correct state.

In any potential sequential equilibrium of Areas III to V, exactly one P-reform is proposed by the l-party and only this one is accepted with probability $\sigma_M^P \in (0,1)$ by the M-group. According to Lemma 14 (p. 108), in all potential sequential equilibria of the game at the most one P-reform is accepted with positive probability. Furthermore, in the areas of Proposition 13, no equilibria with $\sigma_M^P = 0$ can exist because the benefits of holding office are assumed to be relatively high (Assumption 6, p. 95). Consequently, in equilibrium, there can only be exactly one P-proposal which is accepted with positive probability.

In all potential sequential equilibria named in Proposition 13, M is indifferent in accepting the P-proposal, i.e. in all these equilibria the credibility of a P-proposal equals its minimum credibility requirement to be approved ($\mu(\theta = P \mid w^{P,o}) = \tilde{\mu}_P(w^{P,o})$). Obviously, for a given information structure, credibilities of all P-proposals increase in information probabilities σ_{iL} and σ_{iM} (see Table C.3)[7]. Furthermore, the higher the value of the P-proposal, $w^{P,o}$, the higher its minimum credibility requirement is. Therefore, the higher $w^{P,o}$ is, the higher credibilities of P-proposals, and thus the higher information probabilities σ_{iL} and σ_{iM} have to be in equilibrium for a given information structure. We observe the same conditions if we compare information structures $(ninfo, ind)$ and $(ind, info)$. Both types of l inform with a higher probability in $(ind, info)$ than in $(ninfo, ind)$[8]. Accordingly, for a high $w^{P,o}$, i.e. $\tilde{\mu}_P(w^{P,o}) > \frac{1}{1+\lambda}$, sequential equilibria with information structure $(ind, info)$ can constitute but not with $(ninfo, ind)$. The converse is true for $\tilde{\mu}_P(w^{P,o}) < \frac{1}{1+\lambda}$.

These results are due to voters' risk aversion. High $w^{P,o}$-proposals are only accepted, if information probabilities are high, and therefore the probability that the proposed view is correct. If $w^{P,o}$ is small, potential sequential equilibria with $(ind, info)$ do not constitute because this information structure implies a credibility which is too "high" for equilibria in Areas III and IVa. In the case of a small $w^{P,o}$ and $(ind, info)$, the P-proposal would have a credibility that is higher then its minimum credibility requirement. Thus, M would accept the proposal with certainty and best responses of l would no longer be that of Areas III and IVa.

9.2.4 Discussion of Area-VI-Equilibria

The next area we want to consider is Area VI.

[7]In the cases of $(ninfo, ind)$ and (ind, ind), this can be shown by differentiating $\mu^*(\theta = P \mid w^{P,o})$ with respect to σ_{iM}.

[8]An exception is the case of $\tilde{\mu}_P(w^{P,o}) = \frac{1}{1+\lambda}$. There, both information structures are equivalent concerning information probabilities.

Proposition 14

The following strategies constitute potential sequential equilibria in Area VI:

$\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{P,o}, w^{P,o}, w^{P,o})$, $\tilde{\sigma}_l^{\Pi}(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{P,o})$

α_l^L *will never inform;* α_l^M *will inform if* $\alpha_l^M > \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$

- $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, ind)$:
  - *For G-proposals:*
    - *For any* w_b^G:
      GI: $w^{G,u} = w_b^G$ and $w^{G,o} = w_s^G$ with $\sigma_M^G = 1$
      $\mu^*(\theta = G \mid w_b^G) = 1$, $\mu^*(\theta = G \mid w_s^G) = \frac{1}{2}$
    - *If* $\tilde{\mu}_G(w_b^G) \geq \frac{1}{2}$:
      GII: $w^{G,u} = w^{G,o} = w_s^G$ with $\sigma_M^G = 1$
      $\mu^*(\theta = G \mid w_b^G) = \frac{1}{2}$, $\mu^*(\theta = G \mid w_s^G) = 1$
  - *For P-proposals:*
    - *If* $\tilde{\mu}_P(w_s^P) \leq \frac{1}{1+\lambda}$:
      PII: $w^{P,u} = w^{P,o} = w_s^P$ with $\sigma_M^P = 1$
      $\tilde{\mu}_P(w_s^P) \leq \mu^*(\theta = P \mid w_s^P) = \frac{1}{2-(1-\lambda)\sigma_{iM}} \in [\frac{1}{2}, \frac{1}{1+\lambda}]$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{2}$
    - *If* $\tilde{\mu}_P(w_b^P) \leq \frac{1}{1+\lambda}$:
      PIII: $w^{P,u} = w^{P,o} = w_b^P$ with $\sigma_M^P = 1$
      $\mu^*(\theta = P \mid w_s^P) = \frac{1}{2}$, $\tilde{\mu}_P(w_b^P) \leq \mu^*(\theta = P \mid w_b^P) = \frac{1}{2-(1-\lambda)\sigma_{iM}} \in [\frac{1}{2}, \frac{1}{1+\lambda}]$
- $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, info)$:
  - *For G-proposals: Same behavior as with* $(ninfo, ind)$.
  - *For P-proposals:*
    - *If* $\tilde{\mu}_P(w_s^P) \leq \frac{1}{1+\lambda}$:
      PII: $w^{P,u} = w^{P,o} = w_s^P$ with $\sigma_M^P = 1$
      $\mu^*(\theta = P \mid w_s^P) = \frac{1}{1+\lambda}$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{2}$
    - *If* $\tilde{\mu}_P(w_b^P) \leq \frac{1}{1+\lambda}$:
      PIII: $w^{P,u} = w^{P,o} = w_b^P$ with $\sigma_M^P = 1$
      $\mu^*(\theta = P \mid w_s^P) = \frac{1}{2}$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{1+\lambda}$

Potential sequential equilibria in Area VI only exist if $B\Delta\sigma_M \leq 0$, i.e. $\sigma_M^G \leq \sigma_M^P$. In any potential sequential equilibrium, the α_l^M-type informs with positive probability. This means that, given l's best responses in this area, the equilibrium G-proposal has credibility 1. Therefore, it is accepted by M with $\sigma_M^G = 1$. Consequently, σ_M^P also has to be 1, otherwise $B\Delta\sigma_M$ would not be in Area VI.

The information condition for α_l^M, which we state in Proposition 14 already takes into account the fact that $\sigma_M^G = \sigma_M^P = 1$. Whether the equilibria of Propostion 14 exist depends on this information condition and on the size of P-proposals. Only if at least one P-proposal is small enough, i.e. $\tilde{\mu}_P(w^P) \leq \frac{1}{1+\lambda}$, a sequential equilibrium in Area VI exists, which can also be explained by risk aversion. Again, there is exactly one P-proposal that is accepted in equilibrium. M will never accept all P-reforms since the smaller one was out-off-equilibrium and would only have credibility $\frac{1}{2}$.

9.2.5 Discussion of Area-VII-Equilibria

Eventually, we turn to Area VII. There, best responses never include G-proposals. Nevertheless, at least the small G-proposal would have to be accepted if it appeared out-off-equilibrium. Hence, $\sigma_G^M = 1$, and we can conclude that sequential equilibria in Area VII do not exist.

Proposition 15
There are no potential sequential equilibria in Area VII, i.e. there are no equilibria where the l-party proposes $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{P,o}, w^{P,o}, w^{P,o})$ *and* $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{P,u}, w^{P,o}, w^{P,o})$.

9.3 Summary: General Characteristics of Sequential Equilibria

In this section we will summarize and discuss the results we have derived so far concerning the general characteristics of sequential equilibria.

In any sequential equilibrium of the voting game, at least one G-proposal is accepted with certainty, i.e. $\sigma_M^G = 1$. Furthermore, in almost every area where equilibria exist, there are equilibria where M is willing to accept both, the small and the large G-reform. The only exception is Area I, when both types of l do not inform and the large G-reform is too large, i.e. $\tilde{\mu}_G(w_b^G) > \frac{1}{2}$. According to Lemma 13 (p. 108), if the α_l^M-type informs with positive probability, credibility of the large G-reform is 1.

There are no sequential equilibria where $\sigma_M^P > \sigma_M^G$. In this case, the α_l^L-type would never have an incentive to inform. It would just propose P, the best policy for its partisans. Although the α_l^M-type could have an incentive to inform, it could propose the wrong policy even if it knew that $\theta = G$ (Area VII). Furthermore, no type would ever propose G with no information. Therefore, voters can only make α_l^L informing or make both types proposing G with no information, if the chances of reelection are higher with a G-proposal. M-voters may want the party to make a G-proposal if it does not inform, since a G-proposal is less risky for M-voters.

Corollary 2

In any sequential equilibrium of the voting game, at least one G-reform is proposed by l. Furthermore, it always holds that $\sigma_M^G = 1$ *and* $0 \leq \sigma_M^P \leq \sigma_M^G = 1$.

Sequential equilibria in Area I are the only equilibria where $\sigma_M^P = 0$ is possible. The reason is the assumption that benefits B from holding office are relatively high (Assumption 6, p. 95). Therefore, if M-voters reject any P-proposals with certainty, even the α_l^L-type has no incentives to make a P-proposal. It proposes a G-policy to secure reelection and to obtain B, although on economic grounds, it would always prefer a P-policy. If B was smaller it would be conceivable that α_l^L (or α_l^M) proposes a P-reform although M would reject it: Economic concerns would be high enough that l would sacrifice reelection because in this case a P-reform would be implemented by the r-party. Economic concerns of l would be considered indirectly through r. Proposing G and getting reelected would not outweigh the loss in economic terms caused by implementing a G-policy. Nevertheless, the high level of B guarantees that such considerations never make l proposing a P-policy when $\sigma_M^P = 0$. Therefore, sequential equilibria with $\sigma_M^P = 0$ can only be in Area I. Area I is the only area where neither type of l ever proposes P.

Given M's strategy, it depends on the relationship between $B\Delta\sigma_M = B(\sigma_M^G - \sigma_M^P)$ and $\Delta c \Sigma_M^o = \Delta c(\sigma_M^G \Delta w^{G,o} + \sigma_M^P \Delta w^{P,o})$ which sequential equilibria are possible. $B(\sigma_M^G - \sigma_M^P)$ can be interpreted as the expected additional benefit from gaining office by proposing G instead of P. This advantage is compared with $\Delta c(\sigma_M^G \Delta w^{G,o} + \sigma_M^P \Delta w^{P,o})$, the weighted sum of reform effects exceeding the effect $\Delta c w_r^P$ of implementing the alternative w_r^P. The higher $B\Delta\sigma_M$ relative to $\Delta c \Sigma_M^o$, the more weight office concerns have, and l proposes rather G, since G is always accepted with certainty. One polar case is a sequential equilibrium in Area I where both types always propose G. But the higher σ_M^P the lower $B\Delta\sigma_M$, and the more the l-party is willing to propose P. It is willing to take the risk of not being reelected, but instead having a chance of implementing a policy which corresponds to its economic concerns. A sequential equilibrium in Area VI, with $\sigma_M^G = \sigma_M^P = 1$, represents the other polar case where office concerns do not matter at all. Both types behave like they would behave if no elections, i.e. strategic considerations influenced their policy decisions. The α_l^L-type would always propose P, the α_l^M-type could inform if advantages of informing, e.g. $(w^{P,o} - w^{G,u})$, were large enough (see information condition in Proposition 14, p. 121). If they were not large enough, it would also propose P since it always also considers the l-group's interests (compare with Section 8.3.1 "The l-Party's Best Responses").

In Table C.4, we give an overview of all potential sequential equilibria. We name areas, information structures, and the necessary conditions for existence concerning the minimum credibility requirements. For this, we have to distinguish three cases: Sequential equilibria that can only constitute if $\tilde{\mu}_P(w^{P,o}) > \frac{1}{1+\lambda}$, sequential equilibria that can constitute if $\tilde{\mu}_P(w^{P,o}) = \frac{1}{1+\lambda}$, and sequential equilibria with $\tilde{\mu}_P(w^{P,o}) < \frac{1}{1+\lambda}$. The terms "informational quality" and $\text{Prob}^{ob}\{G\}$ are defined and discussed in the next section.

In the following proposition, we name the general characteristics of the voting game's potential sequential equilibria. The proposition summarizes the considerations we have made so far in this chapter and the concrete statements made in Corollary 2 (this section), Lemmas 12 to 14 (Section 9.1.1), and Propositions 11 to 15 (Section 9.2).

Proposition 16
Concerning the sequential equilibria of the voting game, we can make the following general statements:

- *In any sequential equilibrium, at least one G-reform is proposed with strictly positive probability by the l-party.*
- *In any sequential equilibrium, M-voters will accept the small G-reform with certainty.*
- *In any sequential equilibrium, if α_l^M informs with positive probability, and M is willing to accept both G-reforms, the credibility of a w_b^G-proposal is 1.*
- *In any sequential equilibrium, M will accept at the most one P-reform with strictly positive probability.*
- *In any sequential equilibrium, it holds that $\sigma_M^G = 1$ and $\sigma_M^G \geq \sigma_M^P \geq 0$. That is, at least one G-proposal is accepted with certainty by M, and reelection probabilities for P-proposals are never larger than for G-proposals.*
- *For sequential equilibria in Areas III to V it holds that the higher $w^{P,o}$ is, the higher this proposal's credibility is.*

9.4 Informational Quality of Sequential Equilibria

After we have derived all potential sequential equilibria, we wish to analyze their "informational quality". At least for M, it might be important to know - from his point of view - the ex-ante probability that a sequential equilibrium generates a "correct" outcome. This is the ex-ante probability from the agents' viewpoint that a policy is implemented after voting that represents the correct state of the world. The higher this probability, the higher the informational quality of the equilibrium.

Definition 14 (Informational Quality)
The term "informational quality" of a sequential equilibrium denotes - from the agents' viewpoint - the ex-ante probability that a policy is implemented after voting that represents the correct state of the world. Before the play of equilibrium strategies, this probability is assigned by agents within the voting model, i.e., by voters and parties (agents' view).

In Table C.4, we give an overview of the informational quality of all potential sequential equilibria. Furthermore, we give probabilities for the implementation of G, the actual correct view of the economy. This is the probability that an *informed* observer from outside the voting game would assign an equilibrium to generate G as outcome.

Definition 15 ($\text{Prob}^{ob}\{G\}$)
$\text{Prob}^{ob}\{G\}$ *denotes the probability that a sequential equilibrium generates a policy that represents the real state of the world G. This is the probability that an informed observer from outside the voting game would assign a sequential equilibrium to generate G as outcome (observer's view).*

From the *agents' point of view*, a potential sequential equilibrium with information structure $(ind, info)$ generates with probability $\lambda(\frac{1}{2}+\frac{1}{2}\sigma_{iL})+(1-\lambda)$ the correct policy: This information structure is possible in Areas III and IVa. The α_l^L-type informs with probability σ_{iL} and then proposes the correct view. Even if it proposes P and P is refused by M, this policy is implemented with certainty, because the r-party also implemts a P-policy. With probability $(1-\sigma_{iL})$, α_l^L does not inform and proposes P. From the agents' point of view, the ex-ante probability for P being correct is $\frac{1}{2}$. Again, it does not matter whether this view is accepted or not because r implements the same policy. Therefore, the α_l^L-type's behavior generates the correct policy with probability $(\sigma_{iL}+(1-\sigma_{iL})\frac{1}{2})$. The α_l^M-type does always inform and proposes the correct policy. The probability of occurence for the α_l^L-type is λ and for the α_l^M-type is $(1-\lambda)$. In summary, the ex-ante probability from an agent's point of view that a sequential equilibrium with information structure $(ind, info)$ generates the correct policy is $\lambda(\sigma_{iL}+(1-\sigma_{iL})\frac{1}{2})+(1-\lambda)=\lambda(\frac{1}{2}+\frac{1}{2}\sigma_{iL})+(1-\lambda)$.

From the *observer's point of view*, in equilibria of Area III, α_l^M always proposes G: If this type informs, it will learn the real state of the world, and therefore proposes $w^{G,u}$. But even if α_l^M only informs with a probability less than 1, it will propose the correct view, because it also proposes G if it does not inform. The G-proposal is accepted from M with certainty, and hence α_l^M's behavior generates the correct outcome G. The α_l^L-type informs with probability σ_{iL}, and therefore learns G with the same probability. Hence, for a sequential equilibrium of Area III, the probability for the implementation of G from the observer's viewpoint is $(1-\lambda)+\lambda\sigma_{iL}$.

Furthermore, note that - as long as r proposes a P-policy - the voting game always leads to the implementation of the policy which is proposed by l: If l proposes G, it is accepted with certainty. On the other hand, if l proposes P, it is implemented with probability σ_M^P by l and with probability $(1-\sigma_M^P)$ by r. Therefore, the informational quality of an equilibrium corresponds to the probability with which l proposes the correct view from the agents' ex-ante standpoint.

Table C.4 shows that from the observer's point of view, equilibria of Area I are the most efficient since they always generate G. This is in sharp contrast to their informational quality which is the lowest of all potential equilibria (Prob{Area I} $= \frac{1}{2}$). For the informed observer, equilbria with information structure $(ind, info)$ and (ind, ind) are second best. Equilibria with information structure $(ind, info)$ always have a higher informational quality than equilibria with $(ninfo, info)$ and $(ninfo, ind)$. There are no general statements possible about the informational quality of potential equilibria of Area III with (ind, ind). Whether their informational quality is better or worse than those of the other equilibria depends on paramter values. We only know that they have higher quality than equilibria of Area I. Note that the formulas for informational qualities in Table C.4 depend on the values of σ_{iL} and σ_{iM} which in general are not the same for different equilibria.

Obviously, the informational quality of equilibria increases if information probabilities of l, σ_{iL} and σ_{iM}, increase. In our discussion of equilibria in Area III to V (Proposition 13, p. 118), we have learned that σ_{iL} and σ_{iM} are higher, the higher $w^{P,o}$ is, at least for a given information structure. The reason is that the higher $w^{P,o}$ is, the higher the credibility of this proposal has to be to have a chance $\sigma_M^P > 0$ to be accepted. Consequently, information probabilities of l have to be higher for a higher $w^{P,o}$-proposal in order to have a chance to be accepted a posteriori, i.e. after M has observed the proposal in the voting game. A similar structure concerning informational quality can be seen in Table C.4. For relatively low values of $w^{P,o}$, i.e. if $\tilde{\mu}_P(w^{P,o}) < \frac{1}{1+\lambda}$, sequential equilibria with $\sigma_M^P > 0$ have a relatively low informational quality. These are equilibria with information structures $(ninfo, ind)$ and $(ninfo, info)$. For higher values of $w^{P,o}$, i.e. if $\tilde{\mu}_P(w^{P,o}) > \frac{1}{1+\lambda}$, these equilibria cannot constitute. The interpretation is that high values of $w^{P,o}$ may require equilibria with a high informational quality. For example, sequential equilibria with information structure $(ind, info)$ always have a higher informational quality than equilibria with information structures $(ninfo, ind)$ and $(ninfo, info)$.

It is important to note that there are - from the agents' point of view - no sequential equilibria where both types of l inform with certainty and always propose the correct view. This means, there are no sequential equilibria with informational quality of 1. If corresponding strategies were played, M would accept any proposal. This behavior of M cannot constitue an equilibrium because the α_l^L-type would lose any incentive to propose a G-policy, and thus would never inform. On the other hand, we have learned from the discussion of sequential equilibria that if M refused any P-proposal ($\sigma_M^P = 0$), α_l^L would not inform either and always propose G to secure reelection. Therefore, the only "method" for M to induce the α_l^L-type to inform is to accept a P-proposal with a certain probability which is neither zero nor 1. Nevertheless - as we can see from possible information structures named in Table C.4 - there is no sequential equilibrium where α_l^L informs with certainty. Only in Areas III and IVa, are there sequential equilibria where α_l^L is indifferent: III and IVa $(ind, info)$, and III (ind, ind). But these equilibria cannot be equilibria with $\sigma_{iL} = 1$ since if l played this strategy, credibility of the equilibrium P-proposal was 1. Furthermore, if α_l^L would inform with certainty, the α_l^M-type would inform all the more, because it has more incentives than α_l^L. Again, this would lead to $\sigma_M^G = \sigma_M^P = 1$ which cannot be a sequential equilibrium.

In the following proposition, we make general statements concerning informational qualities and $\mathrm{Prob}^{ob}\{G\}$ of sequential equilibria.

Proposition 17

- *For sequential equilibria where exactly one type of l is indifferent concerning its information decision we can make the following general statement (with exception of Area-I- and Area-VI-equilibria): For a given information structure, the higher $w^{P,o}$ is, the higher the informational quality of the equilibrium is.*

- *From the observer's point of view, equilibria in Area I are the most efficient. There we have $\mathrm{Prob}^{ob}\{G\} = 1$. Sequential equilibria with information structures $(ind, info)$ and (ind, ind) are second best. There we have $\mathrm{Prob}^{ob}\{G\} = (1-\lambda) + \lambda\sigma_{iL}$.*

- *As long as the r-party proposes a P-reform the informational quality of a sequential equilibrium equals the probability with which the l-party proposes the correct view from the agents' ex-ante viewpoint.*

- *There are no sequential equilibria with informational quality 1.*

Chapter 10

Discussion and Conclusions

10.1 Existence

According to the overview given in Table C.4, sequential equilibria of Area I are the only sequential equilibria which exist independently of the P-proposals' credibility requirements, since the l-party never makes a P-proposal in these equilibria. Therefore, and because they are the only equilibria where it is possible that both types do not inform, this equilibria exist for a broad range of parameter values. In all other equilibria, information conditions for existence are more restrictive. As discussed in connection with Proposition 11 (p. 115), equilibria in Area I only do not exist if $\alpha_l^M > \frac{1}{2} + \frac{k}{\Delta c\left(w_s^G - w_b^G\right)}$, $\tilde{\mu}_G(w_s^G) > \frac{\lambda}{1+\lambda}$, and $\tilde{\mu}_G(w_b^G) < \frac{1}{2}$. The latter two conditions imply that w_b^G and w_s^G are quite close to each other. Furthermore, the information costs k are low relative to the maximal size Δc of policy effects. If α_l^M informs, it proposes both G-reforms, but then the small one is not sufficiently credible. On the other hand, if neither type of l informs, both G-proposals are "too" credible to sustain a non-information equilibrium ($\tilde{\mu}_G(w_s^G) < \frac{1}{2}$ and $\tilde{\mu}_G(w_b^G) < \frac{1}{2}$). In all other cases, equilibria in Area I exist. In Section 10.3.5, we will show numerical examples.

Sequential Equilibria in Area VI only exist if α_l^M informs with positive probability. The information condition is $\alpha_l^M \geq \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$, which is less restrictive than the information condition for the $(ninfo, info)$-equilibrium of Area I: $\alpha_l^M \geq \frac{1}{2} + \frac{k}{\Delta c(w^{G,o} - w^{G,u})}$. The reason is that the α_l^M-type can gain more by information if it proposes the correct state of the world in the case of $\theta = P$.

For sequential equilibria not in Area I and VI, existence conditions are getting much more complex. The $(ninfo, info)$-equilibria of Areas III, IV, and V only exist if the credibility requirement for the $w^{P,o}$-proposal is fulfilled with equality, i.e., $\tilde{\mu}_P(w^{P,o}) = \frac{1}{1+\lambda}$. For the rest of the potential sequential equilibria named in Table C.4 at least one type of l has to be indifferent concerning its information decision. This means the corresponding information condition has to be fulfilled with equality. Nevertheless, in Section 10.3.5 we will show the existence of IIIa $(ind, info)$, IIIa (ind, ind), and IVb $(ninfo, ind)$.

As discussed above, the existence conditions of Area-I- and Area-VI-equilibria are quite easy to describe. In Section 10.3.5, we will show numerically that they can exist together for the same parameter values. Relationships become more complex if we want to analyze under which conditions the other equilibria can exist together. *With the term "exist together" or "coexist" we mean quilibria that do coexist for different values of σ_M^P, whereas all other strategic variables of M - in particular $w^{P,o}$ - and all parameter values remain constant.*

For sequential equilibria in Area III, where at least one type has the information state of indifference, it is possible to verify that they cannot coexist. Information conditions for all equilibria in this area are the same. If a type is indifferent in an equilibrium, the corresponding condition is fulfilled with equality for exactly one value of σ_M^P, if we take all other strategic variables of M as given, especially $w^{P,o}$. Hence, for a given value of $w^{P,o}$, only one of the equilibria III $(ind, info)$, III (ind, ind), and III $(noinfo, ind)$ can exist, i.e., they do exclude each other. For example, if α_l^L has the information state of indifference like in $(ind, info)$ and (ind, ind), it is not possible for α_l^M to be with the same σ_M^P in the state of information and in the state of indifference. The α_l^M-type is either indifferent or not, but not both. If we compare information conditions for $(ind, info)$ with $(ninfo, ind)$ we recognize that σ_M^P would have to increase to come from an indifferent state of α_l^L to a state of non-information. On the other hand, if σ_M^P increases we never come from the state of information for α_l^M to a state of indifference.

We can also exclude equilibria with high credibility requirements ($\tilde{\mu}_P(w^{P,o}) \geq \frac{1}{1+\lambda}$) from coexistence. These are equilibria III $(ind, info)$, III (ind, ind), and IVa $(ind, info)$. The reason is that IVa $(ind, info)$ has the same indifference condition for α_l^L as III $(ind, info)$ and III (ind, ind), whereas σ_M^P has to be larger in Area IVa than in Area III. Hence, *there can only be at the most one sequential equilibrium with high credibility requirements for a given $w^{P,o}$.*

Finally, as can easily be seen from the information conditions in Tables C.1 and C.2, *there is a critical level of information costs k, above which no type in any area will inform any more. Thus, the only possible sequential equilibrium which is left is I $(ninfo, ninfo)$.*

10.2 Equilibrium Refinements

In this section we wish to discuss whether the occurrence of some sequential equilibria could be more plausible than the occurrence of others. For this, we use the concepts of payoff dominance and the Intuitive Criterion (Cho and Kreps (1987)).

10.2.1 Payoff Dominance

First, we analyze which sequential equilibria could be preferred from players with respect to payoffs. *As we will see in the following, it is not possible to make general statements, as to whether there is an equilibrium which is preferred by both players according to payoff dominance. Nevertheless, it will be helpful to analyze under which circumstances some equilibria might be preferred to others.*

Obviously, a sequential equilibrium in Area VI is quite attractive for the l-party, since each proposal is accepted with certainty and thus, l is reelected with certainty. In this equilibrium, l can behave solely according to its economic concerns. For the α_l^L-type, expected payoff in this equilibrium is the highest of all possible equilibria: Firstly, it always prefers a P-reform on economic grounds[1], and additionally, this is the only equilibrium where $\sigma_M^P = 1$. Secondly, α_l^L does not even have to incur information costs to get reelected. For α_l^M, the equilibrium in VI has a strictly higher payoff than in any other equilibrium where α_l^M informs with positive probability, at least as long as $w^{G,u}$ in Area VI is not smaller than in other equilibria. The reason is that α_l^M wants to propose a P-reform if it learns that $\theta = P$, and is reelected with certainty only in VI. The payoff in VI is also strictly higher than in the Area-I-equilibrium where α_l^M does not inform and chooses to propose $w^{G,o}$: If α_l^M is reelected with certainty it always prefers $w^{P,o}$ with no information. Therefore, proposing a P-reform with no information is better than proposing a G-reform with no information. Furthermore, informing and proposing the correct state of the economy must be better than not informing and proposing P because otherwise, the equilibrium in VI would not exist. Hence, the equilibrium in VI generates a strictly higher payoff for α_l^M than the $(ninfo, ninfo)$-equilibrium of Area I.

In the next step, we want to discuss whether equilibria in Areas III, IV and V are better or worse than equilibria in Area I for the l-party. In an Area-I-equilibrium α_l^L will never inform, it proposes a G-reform but is reelected with certainty. On the other hand, in equilibria of Area III to V, the α_l^L-type does not always inform with positive probability, and then it proposes a P-reform, which is more favorable for this type

[1] It prefers this policy even if it knew that $\theta = G$.

than proposing G with respect to economic concerns. If α_l^L-proposes P, it has to take into account that it is not reelected, but even if this is the case, this type's economic concerns are taken into account by the r-party which will impose a P-reform anyway. Consequently, for the α_l^L-type many equilibria in III to V might be better than an Area-I-equilibrium.

For the α_l^M-type, we can make more exact statements concerning which equilibrium it prefers. First, we compare the Area-I-equilibrium where the α_l^M-type does not inform with the other equilibria. In Areas III and IVb, if α_l^M only informs with probability less than 1 and proposes G with no information, the α_l^M-type is obviously indifferent between the Area-I-$(ninfo, ninfo)$-equilibrium and III- and IVb-equilibria.[2] If α_l^M only informs with probability less than 1 and proposes P with no information, it might be worse off than under Area I with $(ninfo, ninfo)$ because it is indifferent between information and no information and has to take the risk of not being reelected if it proposes P. Furthermore, α_l^M will prefer equilibria in Areas III and IVb where it informs with certainty to the Area-I-$(ninfo, ninfo)$-equilibrium: If it did not prefer these equilibria it would not inform, since it proposed G with no information like in the Area-I-equilibrium. On the other hand, if α_l^M always informs in equilibrium, but would play P with no information (Areas IVa and V), it is not clear whether these equilibria are preferred to I $(ninfo, ninfo)$. This is because reelection is not certain for a P-proposal. Finally, note that we do not have to compare Area-I-equilibria with other equilibria where α_l^M never informs, because such equilibria do not exist.

Now we turn to the Area-I-equilibrium with $(ninfo, info)$. This equilibrium is preferred by α_l^M if it only informs with probability less than 1 and proposes in the case of no information G (Areas III and IVb). The reason is that α_l^M prefers to inform in Area I, because expected payoff is higher than with no information and proposing G. But this is exactly the same payoff that α_l^M obtains in Areas III and IVb with no information and proposing G. If α_l^M only informs with probability less than 1 in Areas IVa and V and proposes P with no information, it is not clear whether the Area-I-equilibrium is still preferred. The reason is that α_l^M prefers a P-proposal with no information on economic grounds and might still prefer this proposal even it lowers chances of reelection. And last but not least, if α_l^M informs with certainty in Area III to V, it might prefer these equilibria to I $(ninfo, info)$ since it always prefers to propose $\theta = P$ if it learns that this is the real state of the world. And even if it was not reelected, at least r will implement his preferred economic policy.

For the M-group, general statements about ex-ante equilibrium preferences are not

[2]If it informs, e.g. in Area III $(ninfo, ind)$, it has to incur information costs, but is better off than in Area I with respect to economic concerns if it learns of and proposes $\theta = P$. In summary, it has the same payoff as in the case of no information.

at all possible. For example, if we compare equilibrium I $(ninfo, info)$ with VI $(ninfo, info)$: From Table C.4, we can see that the informational quality of I $(ninfo, info)$ is only $\frac{1}{2}$, whereas the informational quality of VI $(ninfo, info)$ is $\lambda\frac{1}{2} + (1 - \lambda) = 1 - \frac{1}{2}\lambda > \frac{1}{2}$. Nevertheless, it is far from clear that M would prefer the Area-VI-equilibrium: On the one hand, if, in a VI-$(ninfo, info)$-equilibrium, the $w^{P,o}$-proposal occurs, M knows that this proposal corresponds with probability $1 - \frac{1}{2}\lambda$ to the correct state of the world. On the other hand, if $\theta = G$, and, for example, $w^{P,o} = w_s^P$ is implemented, M might lose more utility than if $w^{G,o} = w_s^G$ was imposed in an Area-I-$(ninfo, info)$-equilibrium in the case of $\theta = P$. The reason is voter's risk aversion represented by a concave utility function and the fact that $w_r^P > \frac{1}{2}$ (compare with the remarks to Proposition 9 in Section 8.3.2 "The M-Group's Best Responses and Beliefs").

In general, for the M-voter, there might be a trade-off between the informational quality of sequential equilibria and risk, i.e., the size and direction of reforms connected with these equilibria: An equilibrium with a small informational quality and small reform sizes might be preferred to an equilibrium with higher informational quality but larger reform sizes. The IVa-$(ninfo, ind)$-reforms might be preferred to the VI-$(ninfo, info)$-reforms, even if the $w^{P,o}$'s are the same, because the "risky" $w^{P,o}$ is only implemented with a probability smaller than one in the IVa-$(ninfo, ind)$-equilibrium. Furthermore, as discussed in the last paragraph, an equilibrium with low informational quality and the possible implementation of a G-reform might be preferred to an equilibrium with a higher informational quality and the possible implementation of a P-reform.

10.2.2 The Intuitive Criterion

In this section, we want to discuss whether the sequential equilibria that we found satisfy the Intuitive Criterion owing to Cho and Kreps (1987). According to the concept of a sequential equilibrium that we have used so far, out-off-equilibrium actions are interpreted as a player's mistake. According to the Intuitive Criterion, out-off-equilibrium actions are interpreted as a message, which is intentionally sent to the other player. An equilibrium satisfies this criterion if there is no incentive for a player to deviate intentionally from his equilibrium actions. In contrast, an equilibrium fails to satisfy the Intuitive Criterion if there is an incentive for a player to deviate.

In a sequential equilibrium of our voting game, at least one type of l might have an incentive to send the following message to M: "Although unexpected by you, I am making an out-off-equilibrium proposal. This should convince you that I am informed about the real state of the world and my proposal is made accordingly. Therefore, you should approve it." The M-group believes this message from its sender if the following conditions are fulfilled:

(i) The other l-type has no incentive to lie: The equilibrium payoff of the other type is strictly larger than if this type had played the out-off-equilibrium proposal but had not informed. The equilibrium payoff is always strictly larger, even if M responded to the message in the most favorable way for this type. In our case, this would mean that M assigned credibility 1 to the unexpected proposal, and therefore approved it with certainty.

(ii) The sender is strictly better off by informing and sending the out-off-equilibrium proposal, as long as M believes that this message can only be made from the sender, and thus, plays its best response accordingly. The reason for this belief of M is that the other type can never do better than in equilibrium by making the out-off-equilibrium-proposal no matter how M reacts (see item (i)).

If these conditions are given, the sender can improve its payoff by deviating, since M would believe his message. Hence, the corresponding equilibrium fails the Intuitive Criterion. In the following, we want to apply these considerations to the sequential equilibria which we have derived in the previous sections (see Tables C.1, C.2, and C.4).

First, we want to discuss whether there is an incentive for a type to inform and to send an out-off-equilibrium-message w_b^P if, in equilibrium, l should make a G-proposal or a w_s^P-proposal, i.e., $w^{P,o} = w_s^P$. Obviously, the α_l^L-type would never inform if M believed that a w_b^P-proposal represented the real state of the world: For this type, as long as it is elected with certainty, it is always best to propose the large P-reform even if it knows that $\theta = G$. Hence, the α_l^L-type has an incentive to lie. Therefore, in turn, the α_l^M-type would not send such an out-off-equilibrium message, since condition (i) would not hold and M would not believe that only an informed α_l^M-type would have sent this message.

If l plays G or w_b^P in equilibrium, i.e., $w^{P,o} = w_b^P$, there may be an incentive for α_l^M to inform and to send the unexpected message w_s^P to M. This type always prefers w_s^P to any G-proposal if it is informed that $\theta = P$. Moreover, in the case of $\theta = P$, α_l^M may also prefer to propose the small P-reform instead of the large one, because it would be reelected with certainty, if M believed with certainty that the message is correct. On the other hand, if α_l^L plays w_b^P in equilibrium, it may still prefer the large P-reform, even though reelection probability in equilibrium for this proposal is smaller than 1. Depending on parameter constellations, we also cannot exclude a situation where α_l^L has an incentive to inform and play w_s^P, whereas α_l^M prefers to stay in equilibrium. For example, the α_l^L-type might prefer to inform and send the out-off-equilibrium message instead of no information and playing w_b^P. This is because of very low information costs and because it would be reelected with certainty when proposing w_s^P.

The third and last possible deviation from equilibrium is an informed w_b^G-proposal instead of a w_s^G-proposal or a P-proposal in equilibrium.[3] The α_l^L-type never has an incentive to deviate to w_b^G: If a G-proposal yielded a better payoff than an equilibrium P-proposal, it would suffice for this type to play w_s^G. This is always economically better for α_l^L than w_b^G, but nevertheless assures reelection. Furthermore, except of the I-$(ninfo, ninfo)$-equilibrium, the α_l^M-type always informs with positive probability, i.e., information is always at least as good as no information. Hence, it can improve its equilibrium payoff by always informing and proposing w_b^G when it learns that $\theta = G$. Consequently, both conditions for a deviation in the sense of the Intuitive Criterion are given if $w^{G,u} = w^{G,o} = w_s^G$, except for Area I $(ninfo, ninfo)$. Therefore, these equilibria fail the Intuitive Criterion, and we can conclude that with this refinement only equilibria survive where the large G-reform is proposed with information.

There is actually no reason for one type to deviate from the I-$(ninfo, ninfo)$-equilibrium to w_b^G. Otherwise, this equilibrium would not exist, i.e., α_l^M would inform in equilibrium (see Proposition 11, p. 115). Furthermore, in none of the Area-I-equilibria will a deviation to a P-proposal take place, because the uninformed α_l^L-type always has an incentive to lie. In summary, all equilibria in Area I satisfy the Intuitive Criterion.

Almost the same holds for the Area-VI-equilibria. If $w^{P,o} = w_s^P$, the α_l^L-type has an incentive to lie by deviating to w_b^P. In the case of $w^{P,o} = w_b^P$ there is no incentive to deviate for either of the two types. Deviations to a G-proposal do not make any sense for the α_l^L-type. As discussed above, the only Area-VI-equilibrium that fails the Intuitive Criterion is the one where w_s^G is proposed from α_l^M in the case of $\theta = G$. The reason is that α_l^M can credibly deviate to w_b^G, and hence strictly improve its payoff.

We are now able to summarize our observations concerning the Intuitive Criterion:

Observation 1 (Intuitive Criterion)

- *Sequential equilibria where w_b^P is played with positive probability may fail the Intuitive Criterion.*
- *Sequential equilibria in Area I always satisfy the Intuitive Criterion.*
- *According to the Intuitive Criterion and except for Area I, only sequential equilibria are played where α_l^M proposes w_b^G with information.*

[3] A deviation w_s^G from a w_b^G-proposal or a P-proposal in equilibrium is not possible since there is no equilibrium where only the large G-reform would be approved (see Lemma 11, p. 107). Moreover, there are no sequential equilibria where only P-proposals are played. Hence, there is no deviation possible where w_s^G could be played as out-off-equilibrium-message. In any equilibrium, at least the small G-proposal is made.

10.3 The Game's Characteristic Sequential Equilibria

In the following, we wish to take a closer look at three different types of sequential equilibria which reveal the characteristic features of the voting process.

10.3.1 Opportunistic Equilibria

First, we analyze equilibria in Area I. We will call them opportunistic equilibria because in these equilibria both types only care about reelection and therefore always propose G. They will propose G even if they prefer a P-proposal on economic grounds, e.g., even if they learn that $\theta = P$ with information. The reason for this behavior is that M rejects any P-proposal with certainty. Furthermore, the benefit B of reelection is high enough that even the α_l^L-type does not refuse reelection although in that case the r-party would implement the optimal policy of this type, i.e., a P-reform. From M's perspective, any P-proposal is rejected with certainty since any P-proposal would be out-off-equilibrium with credibility $\frac{1}{2}$, which is not high enough for the risk-averse voter.

10.3.2 Sincere Equilibria

The second type of equilibria we wish to consider are those in Area VI. We denote them as sincere equilibria in the sense that both types of l behave as if they took only their economic concerns into consideration and as if there were no voting game. If there were no voting game, they would not have to make strategic considerations and they would only act according to their true economic preferences. In a sincere equilibrium l can behave in this way because it is reelected with certainty for any proposed view (G and P). The M-group is willing to accept both views with certainty if the α_l^M-type informs with positive probability and if the probability λ that the l-party is of the α_l^L-type is not "too high". The reason for the latter condition is that this type does not inform and always proposes P.

10.3.3 Highly Informative Equilibria

Finally, we wish to discuss equilibria with information structures $(ind, info)$ and $\sigma_{iL} > 0$ in Areas III and IV. We call them highly informative equilibria. They have both a high informational quality and a high probability of generating the efficient policy outcome G from the observer's point of view (see Section 9.4 "Informational

Quality of Sequential Equilibria"). For a given λ, their informational quality belongs to the highest of all equilibria. Only equilibria in Area III with information structure (ind, ind) could have higher quality.[4] The highly informative equilibria are characterized by a relatively large P-reform ($\tilde{\mu}_P(w^{P,o}) > \frac{1}{1+\lambda}$) and reelection probabilities for a P-reform between 0 and 1. Both characteristics support directly and indirectly a high information probability of both types of l. Directly, because information probabilities σ_{iL} and σ_{iM} have to be high enough that a large P-proposal is credible enough to be approved a posteriori. Indirectly, since highly informative equilibria are supported through an "intermediate" reelection probability σ_M^P in the following sense: If $\sigma_M^P = 0$ there was less incentive to gather information since any P-proposal would be rejected anyway. If $\sigma_M^P = 1$ incentives for gathering information are also smaller since l is reelected anyway. Further, note that the higher the benefits from holding office are, the higher σ_M^P will be. If B is high, there must be a high reelection probability for a P-reform, to cause the l-party informing and not just proposing G to be reelected with certainty.

10.3.4 Summary

As can be seen from Table C.4, opportunistic equilibria exist independently of the P-reforms' credibility requirements. Highly informative equilibria can only constitute if $\tilde{\mu}_P(w^{P,o}) > \frac{1}{1+\lambda}$. In this case, either the probability λ of a α_l^L-type is high, or the proposed P-reform is large, or both. Therefore, the risk-averse M is only willing to accept the P-reform if information probability σ_{iL} of α_l^L is larger than zero. In contrast, a sincere equilibrium does not constitute under this constellation since λ is so high or $w^{P,o}$ is so large that the M-group will not accept a P-proposal with certainty if $\sigma_{iL} = 0$. On the other hand, M will accept both possible views (G and P) in a sincere equilibrium if λ is small or the proposed P-reform is small. Then, $\tilde{\mu}_P(w^{P,o}) \leq \frac{1}{1+\lambda}$, and a highly informative equilibrium cannot constitute, since, if the P-proposal is accepted anyway, the α_l^L-type has no incentive to inform.

10.3.5 Numerical Examples

Suppose we have the following parameter constellation: $\bar{c} = 100$, $\underline{c} = 20$, $B = 80$, $k = 3$, $w_r^P = 0.60$, $w_{sq} = 0.58$, $\lambda = 0.80$, $\alpha_l^L = 0.40$, $\alpha_l^M = 0.62$. Furthermore, we assume that $w_b^G = 0.00$, $w_s^G = 0.56$, and w_s^P and w_b^P are such that $\tilde{\mu}_P(w_s^P) < \frac{1}{1+\lambda}$, and $\tilde{\mu}_P(w_b^P) > \frac{1}{1+\lambda}$.

[4] It is not possible to make general statements about the relationship between (ind, ind)- and $(ind, info)$-equilibria with respect to their informational qualities.

In this case, we obtain a **highly informative (ind, info)-equilibrium in Area IIIa** for $w^{P,o} = w_b^P$ ($\tilde{\mu}_P(w^{P,o}) > \frac{1}{1+\lambda} = 0.556$). In this equilibrium, proposals are $\tilde{\sigma}_l^{\Pi}(\alpha_l^L)^* = (w^{G,o}, w^{P,o}, w^{P,o})$ and $\tilde{\sigma}_l^{\Pi}(\alpha_l^M)^* = (w^{G,u}, w^{P,o}, w^{G,o})$ (see Table C.1) with α_l^L's information probability $\sigma_{iL}{}^*$. Since α_l^L is indifferent concerning its information decision it must hold that $\frac{1}{2}B\Delta\sigma_M{}^* - k = (\frac{1}{2} - \alpha_l^L)\Delta c\Sigma_M^o{}^*$ while α_l^M informs, i.e. $\frac{1}{2}B\Delta\sigma_M{}^* + k < \frac{1}{2}\sigma_M^{P\,*}\Delta c\Delta w^{P,o*} + \sigma_M^{G\,*}\Delta c\left[\left(\alpha_l^M - \frac{1}{2}\right)\Delta w^{G,u*} + \left(1 - \alpha_l^M\right)\Delta w^{G,o*}\right]$. Furthermore, since this equilibrium lies in Area IIIa, we have $(1-\alpha_l^L)\Delta c\Sigma_M^o{}^* \geq B\Delta\sigma_M{}^* > (1-\alpha_l^M)\Delta c\Sigma_M^o{}^*$. In the following table, we give an overview of some possible equilibrium P-proposals, the corresponding beliefs $\mu(\theta = P \mid w^{P,o*}) = \tilde{\mu}_P(w^{P,o*})$, information probabilities $\sigma_{iL}{}^*$ and reelection probabilities $\sigma_M^{P\,*}$. We also list their informational quality, $\text{Prob}\{(ind, info)\} = \lambda(\frac{1}{2} + \frac{1}{2}\sigma_{iL}{}^*) + (1-\lambda)$, and their probability to generate the actually correct view G, $\text{Prob}^{ob}\{G\}$.

Table 10.1: Values for highly informative equilibria in Area IIIa with $w_r^P = 0.60$

$w^{P,o*}$	$\sigma_M^{P\,*}$	$\sigma_{iL}{}^*$	$\mu(\theta = P \mid w^{P,o*}) = \tilde{\mu}_P(w^{P,o*}) = \frac{1}{1+\lambda(1-\sigma_{iL}{}^*)}$	Informational Quality	$\text{Prob}^{ob}\{G\}$
0.77	0.8868	0.030	0.563	0.612	0.224
0.80	0.8817	0.052	0.569	0.621	0.241
0.90	0.8651	0.124	0.588	0.650	0.299
1.00	0.8491	0.200	0.610	0.680	0.360

Finally, the listed highly informative Area-IIIa-equilibria can be fully described by $w^{G,u*} = 0.00$, $w^{G,o*} = 0.56$, $\mu(\theta = G \mid w^{G,u*}) = \mu(\theta = G \mid w^{G,o*}) = 1$, and $\sigma_M^{G\,*} = 1$.[5] From Table 10.1, we can clearly see that the higher $w^{P,o*}$ is, the higher information probabilities, credibilities, information qualities, and Prob G are. Only reelection probabilities $\sigma_M^{P\,*}$ decrease when $w^{P,o*}$ increases: If the reelection probabilitiy did not decrease, the α_l^L-type would no longer inform ($\frac{1}{2}B\Delta\sigma_M - k < (\frac{1}{2} - \alpha_l^L)\Delta c\Sigma_M^o$) since partisan (economic) concerns $\Delta c\Sigma_M^o$ increase when $w^{P,o}$ increases (and σ_M^P remains constant or increases). Therefore, the advantage of gaining office $B\Delta\sigma_M$ by proposing G also has to increase to induce α_l^L to inform with a certain positive probability. Obviously, $B\Delta\sigma_M$ increases when σ_M^P decreases.[6]

As previously discussed, in the case of $\tilde{\mu}_P(w^{P,o}) > \frac{1}{1+\lambda}$ no sincere equilibrium can constitute. Nevertheless, there will be an opportunistic equilibrium for the parameter

[5]Since $\tilde{\mu}_G(w_b^G = 0.00) = 0.575 > \frac{1}{2}$, another possiblity would be that $w^{G,u*} = w^{G,o*} = w_s^G$ (see Proposition 13, p. 118).

[6]For this argumentation, compare with Section 9.3 “Summary: General Characteristics of Sequential Equilibria”.

constellation given above: Credibility requirements for the G-proposals are $\tilde{\mu}_G(w_b^G = 0.00) = 0.575$ and $\tilde{\mu}_G(w_s^G = 0.56) = 0.473$. According to Proposition 11 (p. 115), since $\tilde{\mu}_G(w_s^G) = 0.473 > \frac{\lambda}{1+\lambda} = 0.444$, no $(ninfo, info)$-equilibrium in Area I will exist. But if M plays $w^{G,u} = w^{G,o} = w_s^G$ an **opportunistic** $(\mathbf{ninfo}, \mathbf{ninfo})$**-equilibrium** exists because credibility requirements for the large G-reform exceed $\frac{1}{2}$, and thus, reject the large G-reform if it is proposed unexpectedly is a sequentially rational behavior. In this equilibrium, any P-proposal is rejected with certainty, the equilibrium's informational quality is only $\frac{1}{2}$, but the probabilty of implementing the actually correct view G is 1.

Now suppose that M is only willing to accept the small P-reform with positive probability, i.e., $w^{P,o} = w_s^P$. Then, no highly informative equilibrium can constitute, since we have assumed $\tilde{\mu}_P(w_s^P) < \frac{1}{1+\lambda}$. Instead, a **sincere equilibrium** can constitute if the information condition for Area-VI-equilibria is fulfilled, i.e., $\alpha_l^M > \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$ (see Proposition 14, p. 121). Suppose M plays $w^{G,u} = w_b^G = 0.00$ and $w^{G,o} = w_s^G = 0.56$. Suppose further that $w^{P,o} = 0.70$ with $\tilde{\mu}_P(w^{P,o}) = 0.551 < 0.555 = \frac{1}{1+\lambda}$. In this case, a sincere equilibrium with this strategy of M exists because $0.62 = \alpha_l^M > \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})} = 0.554$. If $w^{P,o} = 0.65$, the corresponding strategies would also constitute an Area-VI-equilibrium with $\frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})} = 0.558$. The informational quality of these equilibria is $\lambda \frac{1}{2} + (1 - \lambda) = 0.6$, and $\text{Prob}^{ob}\{G\} = (1 - \lambda) = 0.2$.

Note that, for the same $w^{P,o}$, sincere and opportunistic or highly informative and opportunistic equilibria can coexist, but sincere and highly informative equilibria.

Finally, suppose that $\lambda = 0.90$. Then, $0.4737 = \frac{\lambda}{1+\lambda} > \tilde{\mu}_G(w_s^G) = 0.4732$, and an **opportunistic equilibrium with** $(\mathbf{ninfo}, \mathbf{info})$**,** $w^{G,u^*} = w_b^G$, and $w^{G,o^*} = w_s^G$ exists since the information condition for α_l^M is fulfilled: $0.62 = \alpha_l^M > \frac{1}{2} + \frac{k}{\sigma_M^G \Delta c(w^{G,o} - w^{G,u})} = 0.567$ with ${\sigma_M^G}^* = 1$ (see Proposition 11, p. 115). A $(ninfo, info)$-equilibrium exists for a higher value of λ because the probability is higher that a w_s^G-proposal is not a lie, i.e., this proposal is not made by the party, although it is informed about $\theta = P$. Because, in a $(ninfo, info)$-equilibrium, the α_l^M-type lies in this way, these equilibria only exist for low probabilities $(1 - \lambda)$ of α_l^M. If $(1 - \lambda)$ is too large, M is not willing to accept even a small G-proposal, because it is very likely to represent the wrong state of the world.

In Appendix B.2, we show numerically the existence of an **Area-IIIa-**$(\mathbf{ind}, \mathbf{ind})$**- and an Area-IVb-**$(\mathbf{ninfo}, \mathbf{ind})$**-equilibrium.**

10.4 The r-Party Proposes the G-View instead of the P-View

In this section, we will discuss which changes in equilibria occur when the r-party proposes a small G-reform w_r^G instead of w_r^P. In this case, Assumption 5 changes slightly, and the order of proposals is now:

$$0 \leq w_b^G < \frac{1}{2} < w_s^G < w_r^G < w_{sq} < w_s^P < w_b^P \leq 1$$

Technically, this behavior of r corresponds to a decrease in w_r^P since the status quo regulation level w_{sq} has no direct influence on the strategic considerations of M or l (see best responses of l and M in previous sections). Nevertheless, there will be changes in the informational quality of equilibria and the probability of reversal from the observer's viewpoint, $\text{Prob}^{ob}\{G\}$.

In the following, we will focus on the three types of equilibria that we discussed in the previous section: opportunistic, sincere, and highly informative equilibria.

First, for the purpose of comparison, we compute Area-IIIa-$(ind, info)$-equilibria with the same parameter values as in the previous section (see Table 10.1) but with $w_r^G = 0.57$ instead of $w_r^P = 0.60$. The results are shown in Table 10.2.

Table 10.2: Values for highly informative equilibria in Area IIIa with $w_r^G = 0.57$

$w^{P,o*}$	${\sigma_M^P}^*$	${\sigma_{iL}}^*$	$\mu(\theta = P \mid w^{P,o*}) = \tilde{\mu}_P(w^{P,o*}) = \frac{1}{1+\lambda(1-\sigma_{iL}{}^*)}$	Informational Quality	$\text{Prob}^{ob}\{G\}$
0.80	0.8824	0.032	0.563	0.599	0.316
0.90	0.8659	0.105	0.583	0.623	0.380
1.00	0.8499	0.182	0.604	0.647	0.444

For the same $w^{P,o*}$, reelection probabilities increase if r proposes w_r^G. This is a general result for the highly informative equilibria and all other equilibria in Areas III, IV, and V where one type of l is indifferent concerning its information decision: If the value of w_r^P decreases to w_r^G, $\Delta w^{G,o}$ decreases by the same amount as $\Delta w^{P,o}$ increases. Since $\Sigma_M^o = \sigma_M^G \Delta w^{G,o} + \sigma_M^P \Delta w^{P,o}$, and $\sigma_M^P < \sigma_M^G$, Σ_M^o decreases. This means, first, that the areas' borders decrease, and, second, in equilibria where one type has been indifferent in his information decision, this indifference is lost (see Tables C.1 and C.2). Consequently, as $B\Delta\sigma_M$ is always the "left-hand-side"-part of the information condition, σ_M^P has to increase for these types of equilibria if w_r^P decreases to w_r^G.

As discussed in Section 9.3 “Summary: General Characteristics of Sequential Equilibria”, we can interpret $\Delta c\Sigma_M^o$ as the weighted sum of reform effects relative to their alternative, which is the proposal of the r-party. If w_r^P decreases to w_r^G, $\Delta c\Sigma_M^o$ decreases relative to the l-party's office concerns, $B\Delta\sigma_M$. If σ_M^P would not change, office concerns would cause l to propose G instead of P to ensure reelection with certainty. Hence, σ_M^P, the probability of reelection when l proposes P, has to increase to induce l to stick with its strategy in the highly informative equilibrium: The α_L^l-type remains indifferent with respect to its information decision. The α_l^L-type needs a higher σ_M^P to propose P because if it is not reelected, r does not impose this types' favored P-policy.

For the sincere and opportunistic equilibria, nothing changes when r makes a G-proposal, since in both types of equilibria l is reelected with certainty anyway: In an opportunistic equilibrium, each type always proposes G with $\sigma_M^G = 1$, and in a sincere equilibrium, we have $\sigma_M^G = \sigma_M^P = 1$.

Furthermore, Table 10.2 shows that information probabilities and credibilities decrease for the same $w^{P,o*}$ when r makes a G-proposal. The reason is a general decrease in credibility requirements for P-proposals. Therefore, in all equilibria where credibilities have to equal credibility requirements (equilibria in Areas III-V), credibilities and information probabilities decrease. The decrease in credibility requirements for a given P-proposal follows directly from the corollary below (The proof is analogous to the proof of Lemma 30 which is part of the proof of Proposition 9. See Appendix B.2):

Corollary 3
Define $\tilde{\mu}_P(w_r^P)$ as

$$\tilde{\mu}_P(w_r^P) := \frac{\sqrt{\bar{c} - w^P \Delta c} - \sqrt{\bar{c} - w_r^P \Delta c}}{\sqrt{\underline{c} + w_r^P \Delta c} - \sqrt{\underline{c} + w^P \Delta c} - \sqrt{\bar{c} - w_r^P \Delta c} + \sqrt{\bar{c} - w^P \Delta c}}.$$

We obtain:

$$\frac{\partial \tilde{\mu}_P}{\partial w_r^P}(w_r^P) > 0 \quad \forall w_r^P \in (0,1) \setminus w^P.$$

The reason for this behavior of $\tilde{\mu}_P(\cdot)$ is the risk aversion of voters. A G-proposal w_r^G has a larger distance to $w^{P,o}$ than w_r^P has. Intuitively, referring to $w^{P,o}$, w_r^G is riskier than w_r^P for voters.

Furthermore, informational qualities, with exception of Area-I- and Area-VI-equilibria (where α_l^M informs with certainty), decrease when w_r^P decreases to w_r^G. The reason is the following: If an l-type does not inform, the ex-ante probability of implementing the correct policy from the agents' viewpoint does not change. Since the agent assigns probability $\frac{1}{2}$ of each view being correct, it does not matter whether the alternative to the l-party's proposal is a G- or a P-policy. But if one type does inform, in all equilibria of Areas III to V, it proposes the correct policy. Hence, if r implements a P-policy when l is not reelected in the case of a P-proposal, r still implements the correct policy. This changes when r proposes G as an alternative. In this case, an informed P-proposal of l is only accepted with probability σ_M^P.

In Table 10.3 we list the new expressions for informational qualities and $\text{Prob}^{ob}\{G\}$. They are derived from the same lines of argumentation as in Section 9.4.

Table 10.3: Informational Quality and $\text{Prob}^{ob}\{G\}$ when the r-party proposes G

Information Structure	Area	Informational Quality	$\text{Prob}^{ob}\{G\}$
	I	$\frac{1}{2}$	1
$(ninfo, info)$	III-VI	$\lambda\frac{1}{2} + (1-\lambda)(\frac{1}{2} + \frac{1}{2}\sigma_M^P)$	$\lambda(1-\sigma_M^P) + (1-\lambda)$
$(ninfo, ind)$	III, IVb	$\lambda\frac{1}{2} + (1-\lambda)(\frac{1}{2} + \frac{1}{2}\sigma_{iM}\sigma_M^P)$	$\lambda(1-\sigma_M^P) + (1-\lambda)$
	IVa, V, VI		$\lambda(1-\sigma_M^P) + (1-\lambda)\cdot$ $(\sigma_{iM} + (1-\sigma_{iM})(1-\sigma_M^P))$
$(ind, info)$	III, IVa	$\lambda(\frac{1}{2} + \frac{1}{2}\sigma_{iL}\sigma_M^P)+$ $(1-\lambda)(\frac{1}{2} + \frac{1}{2}\sigma_M^P)$	$\lambda(1-\sigma_M^P(1-\sigma_{iL}))+$ $(1-\lambda)$
(ind, ind)	III	$\lambda(\frac{1}{2} + \frac{1}{2}\sigma_{iL}\sigma_M^P)+$ $(1-\lambda)(\frac{1}{2} + \frac{1}{2}\sigma_{iM}\sigma_M^P)$	

Concerning the probability of implementing G from the observer's point of view ($\text{Prob}^{ob}\{G\}$), Table 10.3 tells us the following facts (compare with Table C.4):

If r proposes G instead of P, $\text{Prob}^{ob}\{G\}$ remains constant for opportunistic and sincere equilibria. For the $(ninfo, info)$-, Area-III-$(ninfo, ind)$-, and Area-IVb-$(ninfo, ind)$-equilibria, $\text{Prob}^{ob}\{G\}$ even increases. For the remaining equilibria, in particular for highly informative equilibria, it is difficult to make general statements. We observe competing effects. On the one hand, $\text{Prob}^{ob}\{G\}$ should increase, since in the case that the r-party gains power, it implements a G-policy instead of a P-policy. On the other hand, $\text{Prob}^{ob}\{G\}$ should decrease, since credibility requirements decrease when r proposes w_r^G instead of w_r^P and hence, information probabilities also decrease. Furthermore, reelection probabilities for l from implementing P, ${\sigma_M^P}^*$, increase. Obviously, the latter effects lower $\text{Prob}^{ob}\{G\}$. We know that credibility requirements for a given $w^{P,o}$ in the case of w_r^G are the lower compared to w_r^P, the larger the distance between w_r^G and w_r^P is (Corollary3). Hence we should expect a threshold value for $w_r^P - w_r^G$ beyond which $\text{Prob}^{ob}\{G\}$ decreases. That is, $\text{Prob}^{ob}\{G\}$ decreases if $w_r^P - w_r^G$ exceeds the threshold value. This conjecture can be confirmed in many simulations. In the following, we will summarize these observations in a proposition and in a conjecture.

Proposition 18
Suppose the r-party proposes a G-policy w_r^G instead of w_r^P, where

$$\frac{1}{2} < w_s^G < w_r^G < w_{sq} < w_r^P$$

If all other parameter values and strategic variables of M remain constant, we obtain the following results:

(i) Probabilities for implementing G from the observer's point of view, $\mathrm{Prob}^{ob}\{G\}$, increase for the following equilibria: Area-III-to-V-$(ninfo, info)$, Area-III-$(ninfo, ind)$, and Area-IVb-$(ninfo, ind)$. $\mathrm{Prob}^{ob}\{G\}$ remains constant in opportunistic and sincere equilibria.

(ii) For highly informative equilibria, reelection probabilities for P-proposals ${\sigma_M^P}^*$ increase.

(iii) Credibility requirements for P-proposals decrease. Consequently, credibilities for P-proposals in equilibria of Areas III to V decrease. In particular, credibilities for P-proposals in highly informative equilibria decrease.

(iv) Informational qualities of equilibria decrease - with exception of opportunistic equilibria and sincere equilibria. In these types of equilibria, informational qualities remain constant.

Conjecture 2
Suppose the r-party proposes a G-policy w_r^G instead of w_r^P, where

$$\frac{1}{2} < w_s^G < w_r^G < w_{sq} < w_r^P$$

If all other parameter values and strategic variables of M remain constant, we obtain the following result for Area-III-(ind, ind)-, Area-IVa/V-$(ninfo, ind)$- and highly informative equilibria:

Probabilities for implementing G from the observer's point of view, $\mathrm{Prob}^{ob}\{G\}$, increase, if $w_r^P - w_r^G$ is below a certain threshold value. If $w_r^P - w_r^G$ exceeds this threshold value, $\mathrm{Prob}^{ob}\{G\}$ decreases.

10.5 Equilibria when the r-Party Proposes a Regulation Parameter $w_r^P < \frac{1}{2}$

In the previous sections we have analyzed which equilibria could occur in the voting process and with which probabilities $\mathrm{Prob}^{ob}\{G\}$ they lead to the reversal of a wrong policy. As starting point, we have assumed that the correct view G arises on the political agenda when economic conditions have deteriorated heavily after P had been set for a relatively long time such that $w_{sq} > \frac{1}{2}$ (see Section 7.2.3). In this section we wish to analyze whether the emergence of a crisis, i.e., $w_{sq} > \frac{1}{2}$ could also be the outcome of a political process where G is already on the political agenda when the process starts evolving from $w_{sq} < \frac{1}{2}$. A crisis may be the result of a voting process where P-proposals are accepted again and again by voters until the status quo regulation level w_{sq} as well as w_r^P exceed $\frac{1}{2}$.

Formally this means that we will analyze the voting game of the last sections under the assumption that $w_{sq} < \frac{1}{2}$, and thus, that $w_r^P < \frac{1}{2}$. In this case, Proposition 9 (ii), p. 102, tells us that any G-proposal must have a credibility higher than $\frac{1}{2}$ in order to be approved, and that a P-proposal that is close enough to w_r^P has a credibility requirement smaller than $\frac{1}{2}$. *Therefore, to make the situation comparable to the situation where $w_r^P > \frac{1}{2}$, we will assume that $\tilde{\mu}_P(w_s^P) < \frac{1}{2}$, and $\tilde{\mu}_P(w_b^P) > \frac{1}{2}$.* This means, we assume that the small P-reform is "very small" and the large P-reform is "very large". Remember, that we have made the same assumptions concerning the size of G-reforms in the case of $w_r^P > \frac{1}{2}$.

For the derivation of sequential equilibria in the case of $w_r^P < \frac{1}{2}$, we can use the same tables of the l-party's best responses that we have used so far (Tables C.1 and C.2). We only have to take into account that conditions concerning credibility requirements have changed. If l's best responses are those of Areas I to V, at least the small P-reform is accepted with certainty by M. In these Areas, if w_s^P was proposed, it would be either unexpected with credibility $\frac{1}{2}$ or it would have a credibility not smaller than $\frac{1}{2}$. The reason is that in these Areas the l-party never "lies" when it proposes P, i.e., it proposes P either if it is not informed or if it is informed that $\theta = P$. It never proposes P if it learns that $\theta = G$. Therefore, M would accept at least the small P-proposal with certainty, i.e., with $\sigma_M^P = 1$. But then, we have $\sigma_M^P \geq \sigma_M^G$, and hence, there can be no equilibrium in Areas I-V in the case of $w_r^P < \frac{1}{2}$. Instead, we can find sequential equilibria in Areas VI and VII. We obtain the following proposition:

Proposition 19

Suppose that $w_r^P < \frac{1}{2}$. Furthermore, suppose that $\tilde{\mu}_P(w_s^P) < \frac{1}{2}$, and $\tilde{\mu}_P(w_b^P) > \frac{1}{2}$. In this case, there are only potential sequential equilibria in Areas VI and VII.

The following strategies constitute potential sequential equilibria in Area VI:

$\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{P,o}, w^{P,o}, w^{P,o})$, $\tilde{\sigma}_l^{\Pi}(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{P,o})$

α_l^L will never inform; α_l^M will inform if $\alpha_l^M > \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$

- $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, ind)$:
  - *For G-proposals:*

    GII: $w^{G,u} = w^{G,o} = w_s^G$ *with* $\sigma_M^G = 1$

    $\mu^*(\theta = G \mid w_b^G) = \frac{1}{2}$, $\mu^*(\theta = G \mid w_s^G) = 1$

    GIII: $w^{G,u} = w^{G,o} = w_b^G$ *with* $\sigma_M^G = 1$

    $\mu^*(\theta = G \mid w_b^G) = 1$, $\mu^*(\theta = G \mid w_s^G) = \frac{1}{2}$
  - *For P-proposals:*
    * *For any* w_b^P *with* $\tilde{\mu}_P(w_b^P) > \frac{1}{2}$:

      PII: $w^{P,u} = w^{P,o} = w_s^P$ *with* $\sigma_M^P = 1$

      $\mu^*(\theta = P \mid w_s^P) = \frac{1}{2-(1-\lambda)\sigma_{iM}} \in [\frac{1}{2}, \frac{1}{1+\lambda}]$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{2}$
    * *If* $\tilde{\mu}_P(w_b^P) \leq \frac{1}{1+\lambda}$:

      PI: $w^{P,u} = w_s^P$ *and* $w^{P,o} = w_b^P$ *with* $\sigma_M^P = 1$

      $\mu^*(\theta = P \mid w_s^P) = \frac{1}{2}$, $\tilde{\mu}_P(w_b^P) \leq \mu^*(\theta = P \mid w_b^P) = \frac{1}{2-(1-\lambda)\sigma_{iM}} \in [\frac{1}{2}, \frac{1}{1+\lambda}]$
- $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, info)$:
  - *For G-proposals: Same behavior as with* $(ninfo, ind)$.
  - *For P-proposals:*
    * *For any* w_b^P *with* $\tilde{\mu}_P(w_b^P) > \frac{1}{2}$:

      PII: $w^{P,u} = w^{P,o} = w_s^P$ *with* $\sigma_M^P = 1$

      $\mu^*(\theta = P \mid w_s^P) = \frac{1}{1+\lambda}$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{2}$
    * *If* $\tilde{\mu}_P(w_b^P) \leq \frac{1}{1+\lambda}$:

      PI: $w^{P,u} = w_s^P$ *and* $w^{P,o} = w_b^P$ *with* $\sigma_M^P = 1$

      $\mu^*(\theta = P \mid w_s^P) = \frac{1}{2}$, $\mu^*(\theta = P \mid w_b^P) = \frac{1}{1+\lambda}$

The following strategies constitute a potential sequential equilibrium in Area VII:

$\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{P,o}, w^{P,o}, w^{P,o})$, $\tilde{\sigma}_l^{\Pi}(\alpha_l^M) = (w^{P,u}, w^{P,o}, w^{P,o})$

- $\tilde{\sigma}_l^{\mathcal{I}} = (ninfo, ninfo)$:
  - *For G-proposals:*

    GI: $w^{G,u} = w_b^G$ *and* $w^{G,o} = w_s^G$ *with* $\sigma_M^G = 0$

    $\mu^*(\theta = G \mid w_b^G) = \frac{1}{2}$, $\mu^*(\theta = G \mid w_s^G) = \frac{1}{2}$
  - *For P-proposals:*

    PII: $w^{P,u} = w^{P,o} = w_s^P$ *with* $\sigma_M^P = 1$

$$\mu^*(\theta = P \mid w_s^P) = \tfrac{1}{2},\ \mu^*(\theta = P \mid w_b^P) = \tfrac{1}{2}$$

In Area VI, like in Area VII, there could also be a $(ninfo, ninfo)$-equilibrium with $w^{G,u} = w_b^G$, $w^{G,o} = w_s^G$, $\sigma_M^G = 0$, $w^{P,u} = w^{P,o} = w_s^P$, and $\sigma_M^P = 1$. But such an equilibrium would only exist if $B < (2\alpha_l^M - 1)\Delta c(w_s^P - w_r^P)$, which is excluded by Assumption 6 ($B > \Delta c \cdot \max\limits_{w^v} |w^v - w_r^P|$).

In Area VII, the α_l^M-type would only have an incentive to inform if $w^{P,u} = w_s^P$, and $w^{P,o} = w_b^P$. If α_l^M did inform, it would learn $\theta = G$ and, in spite of this, propose $w^{P,u}$. This proposal would have credibility 0, and hence, would be rejected by M. Therefore, $w^{P,u} = w^{P,o}$, and l will never inform in an equilibrium of Area VII.

Within our model, the emergence of a crisis can be easily understood. Although the correct view G is already part of the political agenda, it will never be implemented as long as $w_r^P < \frac{1}{2}$ and $\alpha_l^M < \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$. The latter condition can hold if the α_l^M-type's interests for M's consumption are not very high, information costs k are large, or $w^{P,o}$ and $w^{G,u}$ are quite close to each other. For example, this can be the case if M-voters are only willing to accept the small reform proposals in either direction, i.e., $w^{G,o} = w^{G,u} = w_s^G$ and $w^{P,o} = w^{P,u} = w_s^P$. If $\alpha_l^M < \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$, only the Area-VII-equilibrium is possible where no type of l informs, both types always propose $w^{P,o} = w_s^P$, and M always accepts this proposal with certainty. Thus, w_s^P is implemented, and hence, this proposal becomes the status quo regulation level w_{sq} in the next election campaign. If the r-party's proposal in the next campaign is still smaller than $\frac{1}{2}$, i.e., $w_r^P < \frac{1}{2}$, and the small reform proposals of l are still close enough to each other, the voting process eventually leads to an ever rising regulation level, at least as long as $w_r^P < \frac{1}{2}$.

We summarize our considerations in the following proposition:

Proposition 20

Suppose the status quo regulation level w_{sq} is smaller than $\frac{1}{2}$, the P-proposal of the r-party w_r^P is smaller $\frac{1}{2}$, and the l-party's P-proposals are "very small" and "very large", i.e.,

$$\tilde{\mu}_P(w_s^P) < \frac{1}{2} \qquad \tilde{\mu}_P(w_b^P) > \frac{1}{2}.$$

In this case, there are only sequential equilibria with best response proposals in Areas VI and VII. In particular, if $\alpha_l^M < \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$, only w_s^P will be proposed and implemented.

10.6 Development of Crises Over Time: Conditions for Policy Reversals

In the following, we wish to discuss possible scenarios of how a crisis could develop over time, i.e., under which conditions which equilibria occur together with the corresponding probabilities of reversal $\text{Prob}^{ob}\{G\}$ for all possible $w_r^P \in (0,1)$. For this purpose, we concentrate on opportunistic, sincere, and highly informative equilibria and formulate "rules of thumb". These depend on parameter constellations $\frac{k}{\Delta c}$, λ, and whether $w_r^P < \frac{1}{2}$ or $w_r^P > \frac{1}{2}$. We also analyze in which way the process could be influenced by the behavior of agents. Therefore, we consider changes of the strategic variable $w^{P,o}$. In contrast, we take $w^{G,o} = w_s^G$ and $w^{G,u} = w_b^G$ as given, since we assume that M would always accept w_b^G if it was proposed by l. If M is willing to accept the large G-reform, and it is proposed in equilibrium, M knows with certainty that G is the correct view on the economy (Lemma 13, p. 108). The assumption that M behaves in this way is also in accordance with the Intuitive Criterion (see Observation 1, p. 135). Furthermore, we use the quotient $\frac{k}{\Delta c}$ to simplify the description of information conditions. This can be done by dividing the inequalities given in Tables C.1 and C.2 with Δc, with the exception of the opportunistic and sincere equilibria for which we have already formulated information conditions in this way.

For example, suppose $\frac{k}{\Delta c}$ is very large. In this case, information costs are relatively large compared to the maximal size of reform effects. In other words, the incumbent party would have to incur high information costs, although the maximal improvement of economic conditions is small if it learns of and implements the correct policy. Therefore, we have a "tendency towards" opportunistic equilibria in this case: Suppose the G-view is already part of the political agenda, whereas the regulation level w_{sq} is still lower than $\frac{1}{2}$. As long as $w_r^P < \frac{1}{2}$ and $\frac{k}{\Delta c}$ is very large, we have a "tendency towards" an Area-VII-equilibrium, since this is the only equilibrium possible if $\alpha_l^M < \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$ (see Proposition 20, p. 146). Certainly, depending on the exact values of parameters, we could also obtain an Area-VI-equilibrium, for example if the distance between $w^{P,o}$ and $w^{G,u}$ is large enough. Nevertheless, by "tendency towards"we mean that the value of $\frac{k}{\Delta c}$ is large enough that it determines which equilibrium occurs. We can also call the Area-VII-equilibrium opportunistic since no type of l informs, both types always make a P-proposal, and are nevertheless elected with certainty. After $w^{P,o}$ has been implemented, the next elections take place, the old $w^{P,o}$-value is now the status quo regulation level, and there are new w_r^P-, w_b^P-, etc. proposals. If, after some legislative periods, w_r^P is larger than $\frac{1}{2}$, and $\frac{k}{\Delta c}$ is large enough, we obtain the opportunistic $(ninfo, ninfo)$-equilibrium, and thus a reversal of deteriorating policy with $\text{Prob}^{ob}\{G\} = 1$.[7]

For the entries in the table below, Table 10.4 "Rules of Thumb", we use the following "rules":

Firstly, if $w_r^P < \frac{1}{2}$, there is a tendency towards the opportunistic Area-VII-equilibrium in the case of large values of $\frac{k}{\Delta c}$, and a tendency towards an Area-VI-equilibrium in the case of small values of $\frac{k}{\Delta c}$. We also call the Area-VI-equilibrium with $w_r^P < \frac{1}{2}$ a sincere equilibrium, since both views are accepted with certainty. The only difference from the case where $w_r^P > \frac{1}{2}$ is that in the case of $w_r^P < \frac{1}{2}$, credibility requirements are not restrictive, i.e., such an equilibrium always exists when the information condition is fulfilled, since we have assumed that $\tilde{\mu}_P(w_s^P) < \frac{1}{2}$ (see Proposition 19, p. 144). Concerning the size of $w^{P,o}$ and if $w_r^P < \frac{1}{2}$, we have a tendency towards a sincere equilibrium if $w^{P,o}$ is large, since this is in accordance with the information condition. The larger the difference between $w^{P,o}$ and $w^{G,u}$, the more the information condition $\alpha_l^M \geq \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$ is fulfilled. The reason is that the incentive for α_l^M to inform increases when the value of information $w^{P,o} - w^{G,u}$ increases. The value of information is higher proportional to the level of economic gain from implementing a correct G-reform instead of an incorrect P-reform. On the other hand, if $w^{P,o}$ is small, we have a tendency towards an opportunistic Area-VII-equilibrium concerning the value of $w^{P,o}$. In this case, and if $\frac{k}{\Delta c}$ is small, there is a trade-off in effects between a small value of $\frac{k}{\Delta c}$ and a small value of $w^{P,o}$. Therefore, it is not clear which effect dominates. We do not know whether an opportunistic or a sincere equilibrium occurs, and thus, we say we have a tendency towards both types of equilibria.

Secondly, if $w_r^P > \frac{1}{2}$, we have to consider the following interactions: For large $\frac{k}{\Delta c}$, we have a tendency towards an opportunistic equilibrium. For small $\frac{k}{\Delta c}$, there can be a sincere or a highly informative equilibrium. We have a tendency towards a sincere equilibrium if the probability λ of an α_l^L-type is small, or if $w^{P,o}$ is small (see Table C.4). The reason is that, in these cases, M also accepts a P-reform with certainty, since credibility of this reform is relatively large. This is because the α_l^M-type is very likely and it informs. Furthermore, credibility requirements for small $w^{P,o}$-proposals are small. On the other hand, there is a tendency towards highly informative equilibria, if $w^{P,o}$ is large, or if λ is large. Firstly, if $w^{P,o}$ is large, the proposal is risky for M, and hence, is only accepted when both types inform with positive probability. Secondly, if λ is large, the probability for the occurrence of a α_l^L-type, which cares more about its partisans, is also large. Therefore, as before, a P-proposal can only be accepted when both types inform. Obviously, if λ is small and $w^{P,o}$ is large (or vice versa), there is a

[7] As discussed in Section 10.1 "Existence", there is a threshold for k, and thus for $\frac{k}{\Delta c}$, beyond which only the opportunistic $(ninfo, ninfo)$-equilibrium remains.

trade-off between low risk (high risk) caused by the type of l and high risk (low risk) caused by the size of the proposal. In this case, the result is not unambiguous and there is no tendency towards a special type of equilibrium, since there is one effect towards a sincere equilibrium and one effect towards a highly informative equilibrium. Therefore, depending on the exact proportion of parameter values, both types of equilibria could occur.

Table 10.4: Rules of Thumb

$\frac{k}{\Delta c}$	w_r^P	λ	$w^{P,o}$	tendency towards	$\text{Prob}^{ob}\{G\}$
small	$< \frac{1}{2}$	small	small	sincere/opportunistic (VII)	large: $(1-\lambda)^*$ /0
			large	sincere	large: $(1-\lambda)^*$
		large	small	sincere/opportunistic (VII)	small: $(1-\lambda)^*$ /0
			large	sincere	small: $(1-\lambda)^*$
	$> \frac{1}{2}$	small	small	sincere	large: $(1-\lambda)^*$
			large	sincere/highly informative	large: $(1-\lambda)^*$ / $(1-\lambda)+\lambda\sigma_{iL}$
		large	small	sincere/highly informative	small: $(1-\lambda)^*$ / $(1-\lambda)+\lambda\sigma_{iL}$
			large	highly informative	small: $(1-\lambda)+\lambda\sigma_{iL}$
large	$< \frac{1}{2}$	small	small	opportunistic (VII)	0
			large	sincere/opportunistic (VII)	large: $(1-\lambda)^*$ /0
		large	small	opportunistic (VII)	0
			large	sincere/opportunistic (VII)	small: $(1-\lambda)^*$ /0
	$> \frac{1}{2}$	small/large	small/large	opportunistic (I)	1

*If the information condition is fulfilled with equality, we have $\text{Prob}^{ob}\{G\} = (1-\lambda)\sigma_{iM}$.

After discussing the rules, we can interpret the entries of Table 10.4, "Rules of Thumb".

First, we recognize that the probability of a policy reversal $\text{Prob}^{ob}\{G\}$ is mainly determined by λ. Note that, when $w_r^P < \frac{1}{2}$, $\text{Prob}^{ob}\{G\}$ for the sincere equilibrium is $(1-\lambda)$ like in the case of $w_r^P > \frac{1}{2}$.

Starting from a low regulation level ($w_r^P < \frac{1}{2}$), and with information costs high relative to maximal reform effects Δc, a crisis can develop by an always increasing regulation level, since the opportunistic Area-VII-equilibrium is played (see Proposition 20, previous section). But as soon as w_r^P exceeds $\frac{1}{2}$, a policy reversal occurs with certainty. The reason is risk aversion of voters together with the party's opportunistic behavior, which "accidentally" generates a policy reversal, i.e., the reversal occurs without information.

Observation 2
If $\frac{k}{\Delta c}$ is very large, only opportunistic equilibria exist. Then a policy reversal occurs with certainty as soon as $w_r^P > \frac{1}{2}$.

If information costs are low or reform effects are very high, there are more incentives for the l-party to gather information, and sincere or highly informative equilibria may also occur.[8] The l-party informs since costs are low or because M has too much to lose (Δc is large) and, therefore, only accepts a P-proposal when information probabilities are high. In these equilibria, the higher the probability $(1-\lambda)$ that the l-party supports the M-voters' interests more than those of its partisans, the higher the probability that a policy reversal occurs.

In Table 10.4, we assume "extreme" values to illustrate the basic driving forces of the voting game. Intuitively, if parameter values are "moderate" relative to the values of strategic variables, the behavior of agents can have a great influence on the occurrence of equilibria (in the sense stated in the following observation). Therefore, concerning sincere and highly informative equilibria, the following behavior of M could promote a policy reversal (see also Table C.4 and Propositions 19 and 20 from the previous section):

Observation 3
- *Suppose that $w_r^P < \frac{1}{2}$, $\tilde{\mu}_P(w_s^P) < \frac{1}{2}$, $\tilde{\mu}_P(w_b^P) > \frac{1}{2}$,and $\frac{k}{\Delta c}$ is not too large. In this case a policy reversal could be promoted if M was willing to accept both the large G- and the large P-reform. The reason is that a sincere equilibrium where α_l^M proposes the large G-reform can only occur if $\alpha_l^M \geq \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$ and hence, if $(w^{P,o} - w^{G,u})$ is large. If $\alpha_l^M < \frac{1}{2} + \frac{k}{\Delta c(w^{P,o} - w^{G,u})}$, there is only an opportunistic equilibrium where l always proposes $w^{P,o}$.*

- *Suppose that $w_r^P > \frac{1}{2}$, $\tilde{\mu}_P(w_s^P) \leq \frac{1}{1+\lambda}$, $\tilde{\mu}_P(w_b^P) > \frac{1}{1+\lambda}$, and $\frac{k}{\Delta c}$ is not too large. In this case a policy reversal can be promoted if M accepts none or only the large P-reform, since only highly informative, Area-III-(ind, ind)- and opportunistic equilibria are then possible.*

Concerning the second statement of Observation 3, we can say that a highly informative equilibrium will never occur if M is only willing to accept the small P-reform.

Furthermore, if we consider the second statement of Observation 3 from another perspective, we find a scenario which can explain the persistence of a crisis. Suppose the crisis is already "severe", i.e. $w_r^P > \frac{1}{2}$. Suppose further that λ is relatively large, but the small P-reforms in each voting period are very small. In this case, it is possible

[8] Remember that when $w_r^P > \frac{1}{2}$, opportunistic equilibria are always possible independent of $w^{P,o}$ and λ.

that we always have sincere equilibria since $\tilde{\mu}_P(w_s^P) < \frac{1}{1+\lambda}$, but a relatively low probability of reversal as λ is relatively large ($\text{Prob}^{ob}\{G\} = 1 - \lambda$). The sincere equilibria could be supported by the risk aversion of voters, because their expected payoff ex-ante could be larger in a sincere equilibrium than in a highly informative equilibrium with $w^{P,o} = w_b^P$. The sincere equilibria could also be supported by the l-party since it prefers them in almost all cases (see Section 10.2.1 "Payoff Dominance").

A further question concerning policy reversals is the influence of the r-party's policy proposal on the outcome of the voting process. According to Proposition 18 (p. 142), credibility requirements for P-proposals of l in highly informative equilibria decrease when r makes a G-proposal. The reason is that P-proposals from l appear less risky to M if r makes a w_r^G-proposal instead of a w_r^P-proposal. Therefore, information probabilities in highly informative equilibria decrease. A further consequence is that highly informative equilibria that exist when r makes a P-proposal may disappear when r makes a G-proposal. These effects work against a policy reversal to G and are the larger, the larger the distance between w_r^G and w_r^P is. On the other hand, the fact that the r-party proposes G instead of P works for a policy reversal. According to Conjecture 2 (p. 143), we can therefore make the following statement.

Observation 4
Suppose the r-party proposes a G-reform w_r^G instead of a P-reform w_r^P. If the proposed G-reform is relatively small, i.e., $w_r^P - w_r^G$ is smaller than a particular threshold value, the probability of reversal $\text{Prob}^{ob}\{G\}$ *increases. If the proposed G-reform is relatively large, i.e., $w_r^P - w_r^G$ exceeds the threshold value, the probability of reversal* $\text{Prob}^{ob}\{G\}$ *decreases. The latter result is driven by the risk aversion of voters, since P-proposals from the l-party appear less risky to M when r propses a large G-reform instead of a small G-reform. Thus, M is more willing to accept a P-proposal when the proposed G-reform is large.*

Finally, we want to consider the possibility of a policy reversal when the party in office is an r-party. This means there would be a type of r that cares more about the M-voter (M-type) and another type (R-type) that would care more about its partisans, the R-group, who would always prefer a G-policy. In this case, we would expect a policy reversal at the latest when the policy alternative of the l-party, w_l^P, is larger than $\frac{1}{2}$: Again, a G-proposal would need less credibility than a comparable P-proposal when $w_l^P > \frac{1}{2}$. Therefore, there would be no incentive, either for the R-type or for the M-type, to propose P in equilibrium. Neither of them prefers P under each view like the α_l^L-type does. It is only conceiveable that the M-type proposes P if it learns that $\theta = P$. But this, of course, will never occur. Hence, also the informed M-type would always propose G. Intuitively, we expect the same structure of equilibria for $w_l^P > \frac{1}{2}$

and the r-party in office as for $w_r^P < \frac{1}{2}$ and the l-party in office but with G-proposals instead of the P-proposals in Areas VI and VII. In summary, we can formulate the following conjecture.

Conjecture 3
When the party in office is an r-party that considers the interests of the M- and the R-group, a policy reversal occurs with certainty if the policy alternative of the l-party, w_l^P, exceeds $\frac{1}{2}$.

10.7 Robustness: Discussion of Equilibrium Selection Criteria and other Assumptions

First of all we want to discuss Assumption 6: $B > \Delta c \cdot \max_{w^v} |w^v - w_r^P|$. We assume that the party's benefit from holding office is larger than the maximal possible change in voters' consumption level by reforms. If we interpret B and Δc on the individual level we can regard B as the consumption level an office holder receives for his work and $\Delta c \cdot \max_{w^v} |w^v - w_r^P|$ as the maximal consumption level an individual voter can gain or lose by reform relative to the r-party's proposal. In this context, Assumption 6 implies that office holders earn more than their legislative actions cause for voters. In our opinion, this assumption is plausible since governmental office holders, e.g. prime ministers, usually earn much more than the average citizen. Furthermore, there is also a deeper reasoning for this assumption. From the derivation of the l-party's best response proposals we can conclude[9] that in the case of $B \leq \Delta c \cdot \max_{w^v} |w^v - w_r^P|$, equilibria are conceivable where the l-party chooses a proposal w^v with which it would sacrifice reelection with certainty ($\sigma_M(a \mid w^v) = 0$) although there are other proposals where reelection would occur with positive probability. The reason is that the party's economic concerns would be so high relative to office concerns that the party would give up reelection. Again, this observation shows the empirical plausibility of our assumption: In the history of election campaigns in democracies it is certainly hard to find cases where parties sacrifice reelection for purely economic or partisan concerns. If we gave up Assumption 6, it would be possible that no opportunistic equilibria exist, and in Areas III to V there would be equilibria with $\sigma_M^P = 0$. This means, there would be equilibria where l proposes P although it knows that it is not reelected.

Assumption 5 states that $\frac{1}{2} < w_s^G < w_r^P$, i.e., we assume that the small G-reform is "very small". Therefore, we can conclude from Proposition 9 (i), p. 102, that the minimum credibility requirement for the small G-reform is smaller than $\frac{1}{2}$, i.e., $\tilde{\mu}_G(w_s^G) < \frac{1}{2}$. *If we assumed that the small G-reform was larger such that $\tilde{\mu}_G(w_s^G) > \frac{1}{2}$,*

[9] In Appendix B.1.1, see derivation of Lemma 15.

there would be no opportunistic equilibria, since the minimum credibility requirements even for the small reform would be too high: In an opportunistic equilibrium credibility of $w^{G,o}$ is never higher than $\frac{1}{2}$ (see Section 9.2, Proposition 11). Furthermore, in the case where both G-reforms are large with credibility requirements higher than $\frac{1}{2}$, only in highly informative equilibria are both G-reforms still accepted by M. In all other equilibria, one of the two G-reforms is no longer accepted since it only has credibility $\frac{1}{2}$ (see Section 9.2, Propositions 12 to 15, and Table C.3).

So far we have only analyzed equilibria where at least one proposal is accepted by M with strictly positive probability. Suppose M would reject any proposal. In this case, if any proposal is rejected anyway, there would be no incentives for the l-party to gather information. The l-party would not inform and would propose any of the four possible reforms since it was indifferent between proposals. But then, independently of what l would actually propose, at least the small G-reform would be accepted by M even if it was unexpected since it has credibility $\frac{1}{2}$. Hence, there can be no equilibrium in the voting game where M rejects any proposal with certainty.

In Tables C.1 and C.2 we show l's best responses under the assumption that each type of l chooses the higher regulation level w in the case of indifference. If we give up this assumption and do not restrict l's best response proposal decision in pure strategies, we obtain exactly the same types of equilibria as with restriction. We can justify this observation by the following argumentation.

Best response Tables C.1 and C.2 show that only one type of l ever changes its best response proposal from one area to another - with the exception of Area I to II. In the latter case, additional combinations of best response proposals $\tilde{\sigma}_l^\Pi(\alpha_l^L)$ and $\tilde{\sigma}_l^\Pi(\alpha_l^M)$ are possible, e.g. $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o})$ and $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,o}, w^{G,o}, w^{G,o})$. But in all new combinations the P-proposal would have to be accepted with certainty if it is played in equilibrium. Hence, there can be no additional equilibrium with $\sigma_M^G > \sigma_M^P$. Since in all other "transitions" between areas only one type "changes" its proposals, and hence is indifferent between them if $B\Delta\sigma_M$ equals the areas' borders, no additional combinations of best response proposals to the ones given in the best response tables arise. Therefore, for a given parameter constellation, more equilibria may be found, but the set of all possible types of equilibria does not change.

When we allow for best response proposals in mixed strategies we obtain additional types of equilibria. For example, the following equilibrium is conceivable: Suppose α_l^L is indifferent between its Area II-best-response proposals ($\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o})$) and its Area-III-best-response proposals ($\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o})$). In this case, the α_l^L-type could mix a $w^{G,o}$-proposal with a $w^{P,o}$-proposal if it does not inform. Hence, a $(ninfo, info)$-equilibrium with $\sigma_M^P < 1$ is conceivable because a P-proposal has credibility less than 1 if α_l^L chooses $w^{P,o}$ with positive probability if it does not inform. This $(ninfo, info)$-equilibrium with $\sigma_M^P \in (0,1)$ does not have to fulfill the restrictive condition that $\tilde{\mu}_P(w^{P,o})$ equals exactly $\frac{1}{1+\lambda}$ as is necessary under pure strategies (see Table C.4). Nevertheless, there will be no general advantages of mixed proposal equilibria over pure proposal equilibria concerning informational quality and $\text{Prob}^{ob}\{G\}$. In general, the informational quality of equilibria is restricted since "too high" informational value of proposals makes M accept any view, which in turn leads to the Area-VI-best response proposals with informational quality $\frac{1}{2}\lambda + (1-\lambda)$ (for this argumentation see Section 9.4 "Informational Quality of Sequential Equilibria").

Finally, note that there will also be no additional equilibria with $\sigma_M^P = 1$, since best response proposals in pure strategies are equal in Areas V and VI. There will also be no additional equilibria with $\sigma_M^P = 0$, because from Assumption 6 it follows that $B\Delta\sigma_M$ is strictly larger than $\Delta c \Sigma_M^o$ if $\sigma_M^P = 0$, and hence no mixture between Area I and Area II best response proposals is possible.

In the following, we wish to relax the assumption that reelection probabilities for the two proposals of a certain view have to be equal when both probabilities are strictly positive (Assumption 3, p. 95).

First, we want to analyze a relaxation of Assumption 3 for P-proposals. The derivation of l's best responses can be viewed in Appendix B.1. It is summarized in Lemmas 15 to 28. Obviously, there will always be a P-proposal which can be denoted by $w^{P,o}$ since it is at least as good for l as the other one. For example, in the case of (α_l^L, i, P), α_l^L will choose that P-proposal w_x^P as $w^{P,o}$ which satisfies $\sigma_M(a \mid w_x^P)\{B + \beta_L \Delta w_x^P \Delta c\} > \sigma_M(a \mid w_y^P)\{B + \beta_L \Delta w_y^P \Delta c\}$, where $x, y \in \{s, b\}$, and $x \neq y$ (see equation (B.2)). In the case of $\sigma_M(a \mid w_x^P)\{B + \beta_L \Delta w_x^P \Delta c\} = \sigma_M(a \mid w_y^P)\{B + \beta_L \Delta w_y^P \Delta c\}$, the α_l^L-type is indifferent and can choose a mixture between both proposals. Unfortunately - depending on $\sigma_M(a \mid w_s^P)$ and $\sigma_M(a \mid w_b^P)$ - we cannot exclude a constellation where α_l^L and α_l^M use different $w^{P,o}$'s such that their best response proposals lie in different areas. Only when both types inform and learn that $\theta = P$ would they choose the same $w^{P,o}$ with certainty, since their best response decision in this case does not depend on the values of α_l^L and α_l^M. Because we can expect cases where best response proposals lie in different areas for both types, equilibria are possible with additional information structures. Furthermore, we cannot exclude equilibria where both P-proposals are accepted with different strictly positive probabilities. For example, suppose both types' best responses lie in Area III, α_l^L does not inform and proposes w_b^P, whereas α_l^M does inform and is indifferent between proposing w_s^P and w_b^P under $\theta = P$. In this case, it is conceivable that both proposals are accepted with different probabilities $\in (0,1)$ when α_l^M does not choose w_s^P too often. Obviously, these considerations are only relevant in the case of $\sigma_M(a \mid w_s^P) > \sigma_M(a \mid w_b^P)$. If $\sigma_M(a \mid w_b^P) \geq \sigma_M(a \mid w_s^P)$, then both types will choose w_b^P as $w^{P,o}$, and we obtain the results of the original model, i.e., only one P-proposal will be accepted by voters. Note that all P-proposals are only accepted if they are actually proposed, since, otherwise, they were out-off-equilibrium and, therefore, had to be rejected.

When we give up Assumption 3 and look at G-proposals, we obtain similar results as in the original game. In an equilibrium, the large G-reform can never be accepted alone by M, since, in this case, l would only propose - if anything - the large G-reform. But then, the small one was out-off-equilibrium with credibility $\frac{1}{2}$ and, hence, had to be accepted. Furthermore, if M is willing to accept both G-reforms with positive probability, at least the large one must be proposed and accepted with certainty, i.e., $\sigma_M(a \mid w_b^G) = 1$: Suppose $\sigma_M(a \mid w_b^P) < 1$, then it is possible that only the small reform is proposed, and thus, the large one was out-off-equilibrium with credibility $\frac{1}{2}$. Therefore, it would have to be rejected. If l proposed both reforms, the large one would have credibility 1, since it would only be proposed by α_l^M after it has learned that $\theta = G$. Finally, at least the small G-reform must be proposed and accepted with positive probability. If l did not propose G in equilibrium, the small G-reform would have credibility $\frac{1}{2}$ if it was proposed unexpectedly. But then, $\sigma_M(a \mid w_s^G) = 1$. Furthermore, if G was not proposed, the P-proposals would have no informational value[10], and thus, $\sigma_M(a \mid w_s^P) = \sigma_M(a \mid w_b^P) = 0$. Since $B\Delta\sigma_M > \Delta c \Sigma_M^o$, l's best responses would lie in Area I. Therefore, in any equilibrium, at least the small G-reform must be proposed.

Now we are able to summarize our considerations.

Observation 5

If we allow for any combination of reelection probabilities $\sigma_M(a \mid \cdot)$, we obtain additional types of equilibria. In general, we observe the following characteristics: Either both G-reforms are accepted with $1 = \sigma_M(a \mid w_b^G) \geq \sigma_M(a \mid w_s^G) > 0$ where at least the large one is actually proposed, or only the small reform is proposed and accepted with $\sigma_M(a \mid w_s^G) > 0$. Concerning P-proposals, either none is accepted by M, or only one of the two possible reforms is proposed and accepted with $\sigma_M(a \mid w^P) > 0$, or both are proposed and accepted with $\sigma_M(a \mid w_s^P) > \sigma_M(a \mid w_b^P) > 0$.

Loosely speaking, if we give up Assumption 3, we obtain essentially the same equilibria as with Assumption 3 plus equilibria where both P-reforms are accepted, but the small one with a higher probability.

[10] There would be an informational value if one type of l informed and proposed different P-reforms for different states of the world. But this cannot be an equilibrium, since the wrong P-proposal (for $\theta = G$) would be rejected with certainty and, therefore, cannot be proposed in equilibrium for $\theta = G$, as the best response for l would be to propose the same P-reform as for $\theta = P$.

This observation is in accordance with intuition: The risk-averse voter accepts a small reform with higher probability than a large reform. Furthermore, as in the case of mixed strategies in best response proposals, there is no reason to expect that the additional equilibria have general advantages concerning informational quality and $\text{Prob}^{ob}\{G\}$.

Finally, we want to discuss the assumptions concerning out-off-equilibrium beliefs. So far we have used the fact that any out-off-equilibrium proposal - even if it was played when l changed its information decision - has credibility $\frac{1}{2}$. For this, we had to assume that deviation probabilities from any proposal played in equilibrium to an out-off-equilibrium proposal were the same and that these deviation probabilities are much higher than the deviation probabilities from l's equilibrium information decision (see Section 8.3.2 "The M-Group's Best Responses and Beliefs", Assumption 7). Now suppose M assumes that deviation probabilities from equilibrium information decisions are not negligible. In this case, if one type of l does not inform in equilibrium, but would propose the correct view if it wrongly informed, an out-off-equilibrium proposal can have a credibility higher than $\frac{1}{2}$. For example, best responses in Area II are $\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o})$, and $\tilde{\sigma}_l^{\Pi}(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$. There is no equilibrium in this Area if we assign credibility $\frac{1}{2}$ to an out-off-equilibrium P-proposal. If neither type of l informed, we could obtain an equilibrium in this area if M assigned a credibility to the unexpected $w^{P,o}$-proposal which exactly equals its credibility requirement. Then M was indifferent in accepting this proposal and with $\sigma_M^P > 0$ small enough, we would have found an additional equilibrium in Area II.

In general, if M assigns higher probabilities of the out-off-equilibrium P-proposal being correct, there will be no additional types of equilibria in Areas III to VII. Firstly, in any conceivable information structure in these areas, a P-proposal is made anyway. Secondly, it is not possible there that different P-proposals are made in different information states, since l always chooses $w^{P,o}$ as best response. Therefore, it may be rather possible to "lose" some types of equilibria: If M accepted an out-off-equilibrium P-proposal, this cannot be a w_b^P-proposal, since w_s^P would never be proposed in equilibrium in this case, as only the large P-reform was a best response of M.

If the M-group assigned higher credibility to G-proposals alone, no additional types of equilibria could be found. For small G-reform proposals nothing would change since they are accepted anyway (with exception of the Area-I-$(ninfo, info)$-equilibrium). In contrast, if the large G-reform would always be accepted out-off-equilibrium, only types of equilibria remain with $w^{G,u} = w_b^G$, $w^{G,o} = w_s^G$, and $\sigma_M^G = 1$.

Observation 6

If M assigns higher credibilities to out-off-equilibrium proposals which would represent *the correct state of the world with information, additional types of equilibria may arise in Area II where a P-proposal would be accepted. Concerning G-proposals, there could only remain types of equilibria where both G-reforms are accepted with certainty.*

10.8 Summary and Conclusions

10.8.1 Summary of Equilibria's Characteristics and their Interpretation

In the voting model, we have analyzed under which conditions an economic crisis may persist, aggravate, or be reversed. The crisis stems from a wrongly chosen governmental regulation parameter which is subject to a democratic voting process. The crisis persists when the l-party proposes P. The reason is that either l is reelected or, if not, the r-party gains office and also implements a P-policy. The crisis can be reversed when the incumbent l-party proposes G in its election campaign. In this case, l is reelected with certainty and implements the correct view G.

Without strategic considerations, the α_l^L-type would never inform and always propose a P-policy which corresponds to the interests of its partisans. Furthermore, the α_l^M-type could choose to inform, but only if the economic advantages from proposing the correct policy outweigh information costs. Because the status quo regulation level w_{sq} is set according to a P-policy, i.e., exceeds $\frac{1}{2}$, the risk-averse M-voters demand higher credibility requirements for P- than for comparable G-proposals. Therefore, if l wants to have a chance of being reelected with a P-proposal, although it would almost always propose P without strategic considerations, at least one type of l has to follow a strategy where it informs with positive probability in order to fulfill the corresponding credibility requirements. Nevertheless, P-proposals never have higher reelection probabilities than G-proposals, i.e., $\sigma_M^G \geq \sigma_M^P$. As a matter of fact, any equilibrium G-proposal is accepted with certainty by the risk-averse M-voter. Hence, in opportunistic equilibria where only office concerns matter, both types of l always propose G, and are always reelected with certainty. For highly informative equilibria, the higher the benefit from holding office is, i.e., the higher the incentive to "deviate" to an opportunistic behavior, the higher reelection probabilities for P-proposals have to be in order to prevent l from opportunistic behavior. Only in sincere equilibria (only economic concerns matter), behave both types of l as if there were no strategic considerations necessary to stay in office.

If M is willing to accept both G-reforms, the large G-reform w_b^G will only be proposed by l, if it is informed that $\theta = G$. Therefore, w_b^G has credibility 1, and thus, we should expect that M would always accept the large G-reform if it was proposed by l. This is also in accordance with the Intuitive Criterion where only equilibria survive in which α_l^M proposes w_b^G with information (see Observation 1, p. 135). Furthermore, this result corresponds to the intuition that a large policy change is very credible in the case where ideology or partisans are expected to lead a party to propose the contrary policy (e.g. a “left-wing” party that makes a “right-wing” proposal).

Cukierman and Tommasi (1998) obtain a similar result. In their model, the incumbent party also has office concerns, and also cares about partisan and voters' preferences which depend on the real state of the world. In contrast to our voting model, the real state of the world depends on a normally distributed exogenous shock and not on two discrete theories about the functioning of the economy. Nevertheless, voters are also uncertain about the party's real policy preferences and try to conclude the real shock from the party's proposal, since only the party can observe it (in this case without costs). The main result is that extreme policy positions are more likely to be implemented by parties which are supposed to support the contrary “direction” of policies.

10.8.2 Summary of Conditions for Policy Reversal and their Interpretation

The crucial points concerning policy reversals are the relation between information costs and maximal reform effects ($\frac{k}{\Delta c}$) on the one hand, and the size of M's strategic variable $w^{P,o}$ on the other.

For very high information costs (k) relative to the maximal size of reform effects (Δc) only opportunistic equilibria remain for every $w_r^P \in (0,1)$. In opportunistic equilibria strong office concerns make the parties propose the policy risk-averse voters always accept with certainty. Consequently, starting from $w_r^P < \frac{1}{2}$ the l-party always proposes P and the crisis worsens until it is “severe enough”, i.e., $w_r^P > \frac{1}{2}$, and then it is reversed. In other words, if the maximal consumption loss Δc of a wrong policy is small, crises are reversed with certainty when they are severe enough (see Observation 2, p. 149).

If the maximal consumption loss is large ($\frac{k}{\Delta c}$ is small), the behavior of M may be relevant in the following way (see Observation 3, p. 150): Policy reversals may be promoted, i.e., the probability of reversal may be increased, if M is willing to accept both large reform proposals (G and P). Especially in the case of $w_r^P > \frac{1}{2}$, it may be possible that only highly informative, Area-III-(ind, ind)- and opportunistic equilibria can occur. In these equilibria probabilities of reversal are very high. On the other hand, the persistence of crises for $w_r^P > \frac{1}{2}$ may be explained by the very cautious behavior of an M-group that only accepts small reforms. In this case highly informative equilibria cannot constitute, but sincere equilibria can with relatively low probabilities of reversal. This argument is strengthened by Observation 1 (p. 135) stating that equilibria with large P-reforms may fail the Intuitive Criterion and hence, only sequential equilibria with small P-proposals may remain. Furthermore, the persistence of crises can be the result of a large value for λ (probability that the l-party is of type α_l^L). For example, when sincere equilibria are played, the probability of reversal is small when λ is large, because for sincere equilibria we have $\text{Prob}^{ob}\{G\} = (1-\lambda)$.

If the r-party proposes a G-reform instead of a P-reform, policy reversals may be supported if the proposed G-reform is small, i.e., the distance between w_r^P and w_r^G is small. On the other hand, relatively large G-proposals by r may appear too risky for M relative to a P-proposal by r. Therefore, the probability of reversal decreases (see Observation 4, p. 151).

The role of the l-party's partisan interests can be illustrated by considering the polar case of $\alpha_l^L = 0$ and $\alpha_l^M = 1$. That is, for the α_l^L-type only partisan interests matter whereas the α_l^M-type only cares about the Median-voter. In this case, besides Area-IVb-$(ninfo, ind)$-equilibria, only opportunistic and sincere equilibria can constitute (see Tables C.1, C.2, and C.4). Because in this scenario highly informative equilibria are excluded, we can conclude that strong partisan concerns have negative influence on the possibilities of reversal. Interestingly, as soon as the α_l^L-type leaves its extreme position, i.e., $\alpha_l^L > 0$ and $\alpha_l^M = 1$, highly informative equilibria can constitute.

10.8.3 Conclusions: The Outside Observer, and the Relation to Contemporary and Further Research

In the following we take the standpoint of an outside observer contemplating his influence on the voting game's outcome.

Given the results of our analysis, we are able to consider possible strategic considerations of the so called "experts" (or outside observers) with respect to the structure of the voting process. If we assume that agents within the voting game, i.e., political parties and voters, are ignorant concerning the possibility of strategic behavior of experts, we can suspect the following:

Experts who want to promote the G-view may strategically propose a very small G-reform[11], i.e., $\tilde{\mu}_G(w_s^G) \leq \frac{1}{2}$, because otherwise the opportunistic equilibria for $w_r^P > \frac{1}{2}$, and hence equilibria with reversal probability 1, would not exist (see Proposition 11, p.

[11] For the discussion of experts' possible motivations not always to propose $w^G = 0$ or $w^P = 1$, see Section 7.2.3 "The Starting Point: Crisis and Reform Proposals".

115). On the other hand, the large G-reform will be the largest possible, i.e., $w_b^G = 0$, since it will be accepted with certainty even though it is extreme and, furthermore, it promotes the willingness of α_l^M to inform. For example, in the case of $w_r^P < \frac{1}{2}$, a low value of w_b^G (large G-reform) supports the occurrence of sincere equilibria where α_l^M would propose the large G-reform with certainty. In contrast, if the w_b^G-value was too large, only opportunistic equilibria could constitute where P would be the certain outcome of the voting process in the case of $w_r^P < \frac{1}{2}$ (see Observation 3, first item, p. 150).

On the other hand, experts who prefer the P-view may have an incentive to strategically choose moderate P-reform proposals. If both P-proposals are so small that $\tilde{\mu}_P(w^P) < \frac{1}{1+\lambda}$, no highly informative equilibria exist, and hence, the probability of reversal when no opportunistic equilibrium is played is relatively small.[12]

Nevertheless, the voting model supports contemporary research stating that crises can promote the reversal of detrimental policy.[13] The more severe the crisis is, i.e., the higher w_r^P, the higher the possibility that even $\tilde{\mu}_P(w_s^P) > \frac{1}{1+\lambda}$ (see Corollary 3, p. 141), and thus, only highly informative and opportunistic equilibria can determine the outcome of the election process.[14] At the beginning of a detrimental policy development, risk aversion of voters may support cautious P-policy proposals. But later on, when the status quo regulation level rises too much, risk aversion requests very high credibilities for P-proposals, and hence, promotes highly informative equilibria and eventually a policy reversal.

In our analysis, we have assumed that the opponent r-party does not make strategic considerations concerning its policy proposal. A scenario in which the r-party is willing to make strategic considerations in order to win the elections is the natural extension of our model and may be subject to further research. The main question would be whether this constellation better supports the reversal of a crisis.

[12] In the case of $\tilde{\mu}_P(w^P) < \frac{1}{1+\lambda}$ for both P-proposals the probability of reversal is not larger than $(1-\lambda)$ with the exception of the (ind, ind)-equilibria of Area III. There, $\text{Prob}^{ob}\{G\} = (1-\lambda) + \lambda\sigma_{iL}$, but we expect σ_{iL} to be lower than for highly informative equilibria, since credibility requirements are lower. Furthermore, since in these equilibria both information conditions have to be fulfilled with equality, we expect that the set of parameter constellations where these equilibria are possible is much smaller than for sincere equilibria.

[13] For an overview, see Drazen (2000).

[14] Also remember that the information probability σ_{iL} of the α_l^L-type is higher, the higher the credibility requirement is, and thus, the higher the probability of reversal $\text{Prob}^{ob}\{G\} = (1-\lambda) + \lambda\sigma_{iL}$ is.

Chapter 11

Overall Conclusions

In Part I (Awareness), we showed that neglecting general equilibrium repercussions can lead to a crisis. For this end it was necessary to assume a learning scheme that implemented a certain form of myopia. We justified the learning scheme by deducing from findings in behavioral economics and political economy.

For future research we would suggest empirical work directly analyzing voters' bounded rationality. We need to investigate public discussions, party platforms, and public opinion polls explicitly asking voters what they bear in mind when contemplating economic policy effects. It may be possible to derive from this a falsifiable theory about the forms of myopia voters adopt. With such a theory, predictions about the path of a national economy and economic policy advice could be much more precise and helpful.

As to the problem of economic crises triggered by excessive governmental regulation, we support the view advocated by Bernholz (1982, 2000). Excessive governmental regulation may be the long-run result of a sequence of democratic decisions where rationally uninformed voters successively agree to increases in regulations. At some point in time freedom may be endangered, as there are progressively fewer issues that citizens can decide upon on their own. Consequently, one might argue that the dynamics inherent in democratic decisions may threaten democracy itself as a political system founded on the freedom of its members. Furthermore, the economic crises triggered by excessive regulation may lead to political crises involving further threats to freedom, democracy, and the rule of law. Finally, the dynamics of democracy may even lead to non-democratic regimes claiming that they could solve the political and economic problems more efficiently.

In order to prevent economic crises that might endanger the foundations of democracy and the rule of law, we propose removing the foundations of a free-market economy from the direct influence of the democratic decision-making process. These foundations should be part of the national constitution, which could make them very difficult to change. Examples are the constitutional setting of a maximum total taxation rate per capita or a maximum share of government expenditure. This is in analogy to human rights, which in principle cannot be restricted even if a democratic majority voted to restrict them (e.g., to suppress a minority). Accordingly, these foundations should be supervised by a constitutional court consisting of qualified economists in the same fashion as the protection of human rights is supervised by a court of qualified jurists.

Last but not least, any thorough scientific discussion must point to its own boundaries. The avoidance of severe economic crises - and the preservation of democracy and a free society - is not only a question of political economy. These issues go beyond the scope of economics in that they cannot be completely answered by its methodologies. If we look at recent history, democracy and the rule of law have in many cases been the result of revolution or war.[1] This may be hard to explain convincingly within a purely economic framework. Therefore, to prevent democracy from degenerating back into non-democracy, in the sense of Bernholz, it may be necessary to postulate the occurrence of citizens who are willing to sacrifice their pure self-interests. The findings of political economics may deliver the equipment assuring a functional democracy, but the foundations of democracy can only be found in each individual it ultimately consists of.

[1]Examples are the American War of Independence or the German revolution leading to the Weimar Republic after World War I.

Appendix A

Appendix Part I

Proof of Lemma 2

Under GEV, the utility function of the low-skilled in sector 1 is

$$U_{1l,t}^{GEV} = -2\frac{L_{1l,t}^{GEV}}{\overline{L}_{1l}}\ln(s) + 2\ln(w_{1l,t}) - \ln(p_{1,t}^{GEV}) + 2\ln(s) - 2\ln(2)$$

From this we derive direct verification that $\lim_{w_{1l,t}\to w_{1l}^{max}} U_{1l,t}^{GEV} = -\infty$(by using equations (3.23) and (3.24) and equation (3.20), which implies $\lim_{w_{1l,t}\to w_{1l}^{max}} \tau = \infty$).

Furthermore, we have to show that $\lim_{w_{1l,t}\to 0} U_{1l,t}^{GEV} = \infty$. This is equivalent to showing that $\lim_{w_{1l,t}\to 0} u_{1l,t}^{GEV} = \infty$:

$$\begin{aligned}
u_{1l,t}^{GEV} &= \frac{L_{1l,t}^{GEV}}{\overline{L}_{1l}}\Big(\frac{1}{2}\frac{w_{1l,t}}{p_{1,t}^{GEV}}\Big)^{\frac{1}{2}}\Big(\frac{1}{2}w_{1l,t}\Big)^{\frac{1}{2}} + \frac{\Delta_t^{GEV}}{\overline{L}_{1l}}\Big(\frac{1}{2}\frac{sw_{1l,t}}{p_{1,t}^{GEV}}\Big)^{\frac{1}{2}}\Big(\frac{1}{2}sw_{1l,t}\Big)^{\frac{1}{2}} \\
&= \frac{1}{2}\frac{L_{1l,t}^{GEV}}{\overline{L}_{1l}}w_{1l,t}\frac{1}{\sqrt{p_{1,t}^{GEV}}}(1-s) + \frac{1}{2}sw_{1l,t}\frac{1}{\sqrt{p_{1,t}^{GEV}}} \\
&= \frac{1}{2}\beta\frac{\overline{L}_2}{\overline{L}_{1l}}\frac{1}{(1+\tau_t^{GEV})}\Big(\frac{\overline{L}_{1h}}{\overline{L}_2}\Big)^{\frac{1-\beta}{2}}\Big(\frac{\beta}{w_{1l,t}(1+\tau_t^{GEV})}\Big)^{\frac{\beta}{2}}(1-s) \\
&\quad + \frac{1}{2}sw_{1l,t}^{1-\frac{\beta}{2}}\Big(\frac{\overline{L}_{1h}}{\overline{L}_2}\Big)^{\frac{1-\beta}{2}}\Big(\frac{\beta}{(1+\tau_t^{GEV})}\Big)^{\frac{\beta}{2}}
\end{aligned}$$

Because $\lim_{w_{1l,t}\to 0}(1+\tau_t^{GEV}) = (1-(s\beta)/2)$, the first term goes to infinity and the second term goes to zero if $w_{1l,t}$ approaches zero. Therefore, $u_{1l,t}^{GEV}$ goes to infinity and consequently $U_{1l,t}^{GEV}$ does so too.

Proof of Lemma 3

Because of the continuity of $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$, $\tilde{p}_{1,t}^{PEV}(w_{1l,t}) \geq 0$, $\tilde{p}_{1,t}^{PEV}(0) = 0$ and $\tilde{p}_{1,t}^{PEV}(\tilde{w}_{1l,t}^{PEV,max}) =$

0, $\tilde{w}_{1l,t}^{p_1}$ must be a local maximizer of $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$ in $[0, \tilde{w}_{1l,t}^{PEV,max}]$. Moreover, since $\partial \tilde{p}_{1,t}^{PEV}/\partial w_{1l,t} = 0$ for $w_{1l,t} = \tilde{w}_{1l,t}^{p_1}$, we have

$$\frac{\partial^2 \tilde{p}_{1,t}^{PEV}}{\partial (w_{1l,t})^2}(\tilde{w}_{1l,t}^{p_1}) = \tilde{p}_{1,t}^{PEV}\Big((1-\beta)\frac{-(s\overline{L}_{1l})^2}{(\overline{L}_2 + \tau_{t-1}^{PEV} w_{2,t-1}^{PEV}\overline{L}_2 - s w_{1l,t}\overline{L}_{1l})^2} - \frac{\beta}{(w_{1l,t})^2}\Big) < 0$$

Proof of Lemma 6

The utility function of the low-skilled workers of sector 1 was

$$\tilde{U}_{1l,t}^{PEV}(w_{1l,t}) = -2\frac{\tilde{L}_{1l,t}^{PEV}}{\overline{L}_{1l}}\ln(s) + \ln(w_{1l,t}) + \ln(\frac{w_{1l,t}}{\tilde{p}_{1,t}^{PEV}}) + 2\ln(s) - 2\ln(2)$$

Furthermore, we obtain

$$\frac{w_{1l,t}}{\tilde{p}_{1,t}^{PEV}} = \frac{\beta^\beta}{1+\tau_{t-1}^{PEV}} w_{1l,t}^{1-\beta}\Big(\frac{\overline{L}_{1h}}{\epsilon_t(w_{1l,t})}\Big)^{1-\beta}$$

It can be verified that $\lim_{w_{1l,t}\to\tilde{w}_{1l,t}^{PEV,max}} \tilde{L}_{1l,t}^{PEV} = 0$ (see equations (3.34),(3.38),(3.39)) and $\lim_{w_{1l,t}\to\tilde{w}_{1l,t}^{PEV,max}}(w_{1l,t}/\tilde{p}_{1,t}^{PEV}) = \infty$ (see equations (3.38),(3.39)). Thus, $\tilde{U}_{1l,t}^{PEV}(w_{1l,t})$ goes to infinity as $w_{1l,t}$ approaches $\tilde{w}_{1l,t}^{PEV,max}$. As $\tilde{U}_{1l,t}^{PEV}(w_{1l,t})$ is a continuous function in $[w_{1l}^{min}, \tilde{w}_{1l,t}^{PEV,max})$, the low-skilled cannot do better with any other wage level than $\tilde{w}_{1l,t}^{PEV,max}$.

To show that $\lim_{w_{1l,t}\to 0}\tilde{U}_{1l,t}^{PEV} = \infty$, it is equivalent to show that $\lim_{w_{1l,t}\to 0}\tilde{u}_{1l,t}^{PEV} = \infty$:

$$\begin{aligned}
\tilde{u}_{1l,t}^{PEV} &= \frac{1}{2}\frac{\tilde{L}_{1l,t}^{PEV}}{\overline{L}_{1l}} w_{1l,t}\frac{1}{\sqrt{\tilde{p}_{1,t}^{PEV}}}(1-s) + \frac{1}{2}s w_{1l,t}\frac{1}{\sqrt{\tilde{p}_{1,t}^{PEV}}} \\
&= \frac{1}{2}\frac{1}{\overline{L}_{1l}}\beta\epsilon_t(w_{1l,t})\frac{1}{(1+\tau_{t-1}^{PEV})^{\frac{1}{2}}}\Big(\frac{\overline{L}_{1h}}{\epsilon_t(w_{1l,t})}\Big)^{\frac{1-\beta}{2}}\Big(\frac{\beta}{w_{1l,t}}\Big)^{\frac{\beta}{2}} \\
&\quad + \frac{1}{2}s w_{1l,t}^{1-\frac{\beta}{2}}\frac{1}{(1+\tau_{t-1}^{PEV})^{\frac{1}{2}}}\Big(\frac{\overline{L}_{1h}}{\epsilon_t(w_{1l,t})}\Big)^{\frac{1-\beta}{2}}\beta^{\frac{\beta}{2}}
\end{aligned}$$

As τ_{t-1}^{PEV} is taken as given and $\epsilon_t(w_{1l,t})$ approaches $\tilde{w}_{1l,t}^{PEV,max}$, the first term goes to infinity and the second to zero. Therefore, $\lim_{w_{1l,t}\to 0}\tilde{U}_{1l,t}^{PEV} = \infty$.

Since we obtain a polynomial of degree 2 in $w_{1l,t}$ for $\partial\tilde{U}_{1l,t}^{PEV}/\partial w_{1l,t} = 0$, there could be two local optima in $(0, \tilde{w}_{1l,t}^{PEV,max})$. But we can verify that there is only one local optimum - a minimizer - in this area because $\tilde{U}_{1l,t}^{PEV}(w_{1l,t})$ goes to infinity for $w_{1l,t} \to 0$ and $w_{1l,t} \to \tilde{w}_{1l,t}^{PEV,max}$ and $\tilde{U}_{1l,t}^{PEV}(w_{1l,t})$ is a continuous function in $(0, \tilde{w}_{1l,t}^{PEV,max})$.

Proof of Proposition 2

Equation (3.39) gives us the general connection between the Condorcet winner in one period and the previous period's realized tax rate and sector-2 wage values:

$$\hat{w}_{1l,t+1}^{PEV} = \frac{\overline{L}_2 + \tau_t^{PEV} w_{2,t}^{PEV} \overline{L}_2}{s\overline{L}_{1l}}$$

Thus the Condorcet winner in period zero is

$$\hat{w}_{1l,0}^{PEV} = \frac{\overline{L}_2 + \tau_r w_{2,r} \overline{L}_2}{s\overline{L}_{1l}}$$

Using $w_2 = 1/(1+\tau)$ (see equation (3.22)), we obtain

$$\hat{w}_{1l,0}^{PEV} = \frac{\overline{L}_2 + \frac{\tau_r}{1+\tau_r}\overline{L}_2}{s\overline{L}_{1l}} = \frac{\overline{L}_2 + \frac{\tau_r}{1+\tau_r}\overline{L}_2 - \frac{1+\tau_r}{1+\tau_r}\overline{L}_2 + \overline{L}_2}{s\overline{L}_{1l}} = \frac{2\overline{L}_2 - \frac{1}{1+\tau_r}\overline{L}_2}{s\overline{L}_{1l}}$$

With equations (3.20) and (3.22) we find in general

$$w_{2,t}^{PEV} = \frac{2\overline{L}_2 - s w_{1l,t}^{PEV} \overline{L}_{1l}}{\overline{L}_2(s\beta - 2)}$$

and therefore

$$w_{2,0}^{PEV} = \frac{2\overline{L}_2 - s\hat{w}_{1l,0}^{PEV} \overline{L}_{1l}}{\overline{L}_2(s\beta - 2)} = \frac{1}{(2 - s\beta)(1+\tau_r)}$$

Thus the tax rate in period zero is

$$\tau_0^{PEV} = (2 - s\beta)(1+\tau_r) - 1.$$

Inserting $w_{2,0}^{PEV}$ and τ_0^{PEV} in (3.39) we have

$$\hat{w}_{1l,1}^{PEV} = \frac{2\overline{L}_2 - \frac{1}{(2-s\beta)(1+\tau_r)}\overline{L}_2}{s\overline{L}_{1l}}$$

and therefore

$$\begin{aligned} w_{2,1}^{PEV} &= \frac{1}{(2-s\beta)^2(1+\tau_r)} \\ \tau_1^{PEV} &= (2-s\beta)^2(1+\tau_r)-1 \end{aligned}$$

Continuing in this fashion, we obtain Proposition 2.

Proof of Lemma 8

With equations (5.2) and (5.4), the perceived utility function of the high-skilled workers of sector 1 is

$$\begin{aligned} \tilde{U}_{1h,t}^{PEV1} &= \ln\Big\{\frac{1}{2}(1-\beta)w_{2,t-1}^{PEV1}\Big(\frac{sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2}{(s\beta+2\tau_{t-1}^{PEV1}+1)w_{2,t-1}^{PEV1}\overline{L}_{1h}}\Big)^{\beta}\Big(\frac{\beta}{(1+\tau_{t-1}^{PEV1})w_{1l,t}}\Big)^{\beta}\Big\} \\ &\quad +\ln\Big\{\frac{1}{2}\Big(\frac{(1-\beta)(sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2)}{(s\beta+2\tau_{t-1}^{PEV1}+1)\overline{L}_{1h}}\Big)\Big\} \\ &= 2\ln\Big\{\frac{1}{2}\Big\}+\ln\Big\{(1-\beta)w_{2,t-1}^{PEV1}\Big\}+\beta\ln\Big\{\beta\Big\}-\beta\ln\Big\{(s\beta+2\tau_{t-1}^{PEV1}+1)w_{2,t-1}^{PEV1}\overline{L}_{1h}\Big\} \\ &\quad +\beta\ln\Big\{sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2\Big\}-\beta\ln\Big\{(1+\tau_{t-1}^{PEV1})w_{1l,t}\Big\}+\ln\Big\{1-\beta\Big\} \\ &\quad +\ln\Big\{sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2\Big\}-\ln\Big\{(s\beta+2\tau_{t-1}^{PEV1}+1)\overline{L}_{1h}\Big\} \\ &= (1+\beta)\ln\Big\{sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2\Big\}-\beta\ln\Big\{(1+\tau_{t-1}^{PEV1})w_{1l,t}\Big\}+const \end{aligned}$$

where *const* refers to the terms that do not depend on $w_{1l,t}$. We can rewrite the last expression for $\tilde{U}_{1h,t}^{PEV1}$ as

$$\begin{aligned} \tilde{U}_{1h,t}^{PEV1} &= \ln\Big\{sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2\Big\}+\beta\ln\Big\{\frac{sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2}{(1+\tau_{t-1}^{PEV1})w_{1l,t}}\Big\}+const \\ &= \ln\Big\{sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2\Big\}+\beta\ln\Big\{\frac{s\overline{L}_{1l}+\frac{w_{2,t-1}^{PEV1}\overline{L}_2}{w_{1l,t}}}{1+\tau_{t-1}^{PEV1}}\Big\}+const \end{aligned}$$

Since *const* is finite it follows immediately that $\lim_{w_{1l,t}\to 0}\tilde{U}_{1h,t}^{PEV1}(w_{1l,t})=\infty$ and $\lim_{w_{1l,t}\to\infty}\tilde{U}_{1h,t}^{PEV1}(w_{1l,t})=\infty$.

To derive the optima, we differentiate $\tilde{U}_{1h,t}^{PEV1}$ with respect to $w_{1l,t}$:

$$\begin{aligned} \frac{\partial\tilde{U}_{1h,t}^{PEV1}}{\partial w_{1l,t}} &= (1+\beta)\frac{s\overline{L}_{1l}}{sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2}-\frac{\beta}{w_{1l,t}} \\ &= \frac{(1+\beta)sw_{1l,t}\overline{L}_{1l}-\beta(sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2)}{(sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2)w_{1l,t}} \\ &= \frac{sw_{1l,t}\overline{L}_{1l}-\beta w_{2,t-1}^{PEV1}\overline{L}_2}{(sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2)w_{1l,t}} \end{aligned}$$

Equating the last expression with zero yields

$$\tilde{w}_{1l,t}^{PEV1,min_{1h}} = \frac{1}{(1+\tau_{t-1}^{PEV1})s}\beta\frac{\overline{L}_2}{\overline{L}_{1l}}$$

This is a local minimizer because

$$\frac{\partial^2 \tilde{U}_{1h,t}^{PEV1}}{\partial(w_{1l,t})^2}(\tilde{w}_{1l,t}^{PEV1,min_{1h}}) = \frac{sw_{1l,t}\overline{L}_{1l}(sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2)}{(sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2)^2(w_{1l,t})^2} > 0$$

Proof of Lemma 9

We use $\tilde{u}_{1l,t}^{PEV1}$ instead of $\tilde{U}_{1l,t}^{PEV1}$:

$$\begin{aligned}
\tilde{u}_{1l,t}^{PEV1} &= \frac{1}{2}\frac{\tilde{L}_{1l,t}^{PEV1}}{\overline{L}_{1l}}(1-s)w_{1l,t}\frac{1}{\sqrt{\tilde{p}_{1,t}^{PEV1}}} + \frac{1}{2}sw_{1l,t}\frac{1}{\sqrt{\tilde{p}_{1,t}^{PEV1}}} \\
&= \frac{1}{2\overline{L}_{1l}}(1-s)\frac{\beta(sw_{1l,t}\overline{L}_{1l}+w_{2,t-1}^{PEV1}\overline{L}_2)}{(s\beta+2\tau_{t-1}^{PEV1}+1)}\Big(\frac{(s\beta+2\tau_{t-1}^{PEV1}+1)\overline{L}_{1h}}{(1+\tau_{t-1}^{PEV1})sw_{1l,t}\overline{L}_{1l}+\overline{L}_2}\Big)^{\frac{1-\beta}{2}}\Big(\frac{\beta}{(1+\tau_{t-1}^{PEV1})w_{1l,t}}\Big)^{\frac{\beta}{2}} \\
&\quad+\frac{1}{2}sw_{1l,t}\Big(\frac{(s\beta+2\tau_{t-1}^{PEV1}+1)\overline{L}_{1h}}{(1+\tau_{t-1}^{PEV1})sw_{1l,t}\overline{L}_{1l}+\overline{L}_2}\Big)^{\frac{1-\beta}{2}}\Big(\frac{\beta}{(1+\tau_{t-1}^{PEV1})w_{1l,t}}\Big)^{\frac{\beta}{2}} \\
&= \frac{1}{2\overline{L}_{1l}}(1-s)\beta^{1+\frac{\beta}{2}}(\overline{L}_{1h})^{\frac{1-\beta}{2}}\Big(\frac{1}{s\beta+2\tau_{t-1}^{PEV1}+1}\Big)^{\frac{1+\beta}{2}}w_{2,t-1}^{PEV1}\Big(\frac{(1+\tau_{t-1}^{PEV1})sw_{1l,t}\overline{L}_{1l}+\overline{L}_2}{(1+\tau_{t-1}^{PEV1})w_{1l,t}}\Big)^{\frac{\beta}{2}} \\
&\quad\cdot\Big((1+\tau_{t-1}^{PEV1})sw_{1l,t}\overline{L}_{1l}+\overline{L}_2\Big)^{\frac{1}{2}}+\frac{1}{2}s\Big(\frac{\beta}{1+\tau_{t-1}^{PEV1}}\Big)^{\frac{\beta}{2}}\Big((s\beta+2\tau_{t-1}^{PEV1}+1)\overline{L}_{1h}\Big)^{\frac{1-\beta}{2}} \\
&\quad\cdot\Big(\frac{w_{1l,t}}{(1+\tau_{t-1}^{PEV1})sw_{1l,t}\overline{L}_{1l}+\overline{L}_2}\Big)^{\frac{1-\beta}{2}}(w_{1l,t})^{\frac{1}{2}} \\
&= const_1\cdot\Big(\frac{(1+\tau_{t-1}^{PEV1})sw_{1l,t}\overline{L}_{1l}+\overline{L}_2}{(1+\tau_{t-1}^{PEV1})w_{1l,t}}\Big)^{\frac{\beta}{2}}\Big((1+\tau_{t-1}^{PEV1})sw_{1l,t}\overline{L}_{1l}+\overline{L}_2\Big)^{\frac{1}{2}} \\
&\quad+const_2\cdot\Big(\frac{w_{1l,t}}{(1+\tau_{t-1}^{PEV1})sw_{1l,t}\overline{L}_{1l}+\overline{L}_2}\Big)^{\frac{1-\beta}{2}}(w_{1l,t})^{\frac{1}{2}} \\
&= const_1\cdot\Big(\frac{(1+\tau_{t-1}^{PEV1})s\overline{L}_{1l}+\frac{\overline{L}_2}{w_{1l,t}}}{(1+\tau_{t-1}^{PEV1})}\Big)^{\frac{\beta}{2}}\Big((1+\tau_{t-1}^{PEV1})sw_{1l,t}\overline{L}_{1l}+\overline{L}_2\Big)^{\frac{1}{2}} \\
&\quad+const_2\cdot\Big(\frac{1}{(1+\tau_{t-1}^{PEV1})s\overline{L}_{1l}+\frac{\overline{L}_2}{w_{1l,t}}}\Big)^{\frac{1-\beta}{2}}(w_{1l,t})^{\frac{1}{2}}
\end{aligned}$$

Note that $const_1$ and $const_2$ are finite. The first term approaches infinity and the second term zero when $w_{1l,t}\to 0$. For $w_{1l,t}\to\infty$, both terms approach infinity. This proves the lemma's first statement (i): $\tilde{U}_{1l,t}^{PEV1}(w_{1l,t})\to\infty$ for $w_{1l,t}\to 0$ and $w_{1l,t}\to\infty$.

Since we obtain a polynomial of degree 2 in $w_{1l,t}$ for $\partial\tilde{U}_{1l,t}^{PEV1}/\partial w_{1l,t}=0$, there could be two local optima in $w_{1l,t}\in(0,\infty)$. But we can conclude that there is exactly one local minimizer $\tilde{w}_{1l,t}^{PEV1,min_{1l}}$ in this area because of the continuity of $\tilde{U}_{1l,t}^{PEV1}(w_{1l,t})$ and the characteristics of $\tilde{U}_{1l,t}^{PEV1}(w_{1l,t})$ stated in (i). This minimum can be smaller or larger than the market-clearing minimum wage. For the parameter values $s = 0.1, \beta = 0.4, \overline{L}_{1l} = 70,000, \overline{L}_{1h} = 50,000$ and $\overline{L}_2 = 100,000$, we obtain $w_{1l}^{min} = 0.57$ and $w_{1l}^{max} = 28.57$. In this case we obtain $\tilde{w}_{1l,t}^{PEV1,min_{1l}} = 0.79$ for $\tau_{t-1}^{PEV1} = 0.3$ and $\tilde{w}_{1l,t}^{PEV1,min_{1l}} = 0.27$ for $\tau_{t-1}^{PEV1} = 1.0$.[1]

Proof of Lemma 10

According to the definition of $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$ (see Chapter 5.2.2), $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu}) = w_{1l}^{min}$ if $\tilde{w}_{1l,t}^{PEV1,min_{1h}} = w_{1l}^{min}$, i.e. the minimizer of $\tilde{U}_{1h,t}^{PEV1}(w_{1l,t})$ and w_{1l}^{min} coincide. But this is the case if $\tau_{t-1}^{PEV1} = \frac{1-s}{s}$ (see Lemma 8). Hence, $\tilde{w}_{1l,t}^{crit,1h}(\frac{1-s}{s}, \bar{\nu}) = w_{1l}^{min}$.

The perceived utility functions of the high-skilled workers in period t depend not only on $w_{1l,t}$ but also on τ_{t-1}^{PEV1}. We obtain the following relationship:

$$
\begin{aligned}
& \tilde{U}_{1h,t}^{PEV1}(w_{1l}^{min}, \tau_{t-1}^{PEV1}) = \tilde{U}_{1h,t}^{PEV1}(w_{1l,t}, \tau_{t-1}^{PEV1}) \\
\Leftrightarrow \quad & \ln\Big(\frac{\tilde{w}_{1h,t}^{PEV1}(w_{1l}^{min}, \tau_{t-1}^{PEV1})}{\tilde{p}_{1,t}^{PEV1}(w_{1l}^{min}, \tau_{t-1}^{PEV1})}\Big) + \ln\Big(\tilde{w}_{1h,t}^{PEV1}(w_{1l}^{min}, \tau_{t-1}^{PEV1})\Big) = \ln\Big(\frac{\tilde{w}_{1h,t}^{PEV1}(w_{1l,t}, \tau_{t-1}^{PEV1})}{\tilde{p}_{1,t}^{PEV1}(w_{1l,t}, \tau_{t-1}^{PEV1})}\Big) \\
& + \ln\Big(\tilde{w}_{1h,t}^{PEV1}(w_{1l,t}, \tau_{t-1}^{PEV1})\Big) \\
\Leftrightarrow \quad & \big(1 + s\beta + s\beta\tau_{t-1}^{PEV1}\big)\big(\overline{L}_{1l}{}^{\beta}\overline{L}_2\big)^{\frac{1}{1+\beta}} - (1 + \tau_{t-1}^{PEV1})s\beta^{\frac{\beta}{1+\beta}}\overline{L}_{1l} \cdot (w_{1l,t})^{\frac{1}{1+\beta}} \\
& -\beta^{\frac{\beta}{1+\beta}}\overline{L}_2 \cdot (w_{1l,t})^{-\frac{\beta}{1+\beta}} = 0 \qquad \text{(A.1)}
\end{aligned}
$$

We can define a function $F(\tau_{t-1}^{PEV1}, w_{1l,t})$ as the left-hand side of the last equation:

$$F(\tau_{t-1}^{PEV1}, w_{1l,t}) := \big(1+s\beta+s\beta\tau_{t-1}^{PEV1}\big)\big(\overline{L}_{1l}{}^{\beta}\overline{L}_2\big)^{\frac{1}{1+\beta}} - (1+\tau_{t-1}^{PEV1})s\beta^{\frac{\beta}{1+\beta}}\overline{L}_{1l}\cdot(w_{1l,t})^{\frac{1}{1+\beta}} - \beta^{\frac{\beta}{1+\beta}}\overline{L}_2\cdot(w_{1l,t})^{-\frac{\beta}{1+\beta}}$$

The partial derivative of $F(\tau_{t-1}^{PEV1}, w_{1l,t})$ with respect to τ_{t-1}^{PEV1} is

$$\frac{\partial F}{\partial \tau_{t-1}^{PEV1}}(\tau_{t-1}^{PEV1}, w_{1l,t}) = s\beta(\overline{L}_{1l})^{\frac{\beta}{1+\beta}}(\overline{L}_2)^{\frac{1}{1+\beta}} - s\beta^{\frac{\beta}{1+\beta}}\overline{L}_{1l} \cdot (w_{1l,t})^{\frac{1}{1+\beta}}$$

If we insert $w_{1l}^{min} = \beta\frac{\overline{L}_2}{\overline{L}_{1l}}$ for $w_{1l,t}$ in $\frac{\partial F}{\partial \tau_{t-1}^{PEV1}}(\tau_{t-1}^{PEV1}, w_{1l,t})$, we obtain

$$\frac{\partial F}{\partial \tau_{t-1}^{PEV1}}(\tau_{t-1}^{PEV1}, w_{1l}^{min}) = 0 \qquad \text{(A.2)}$$

[1]We have obtained these values by using the MAPLE software package in the following way: We differentiate $\tilde{U}_{1l,t}^{PEV1}(w_{1l,t})$ with respect to $w_{1l,t}$ and set the resulting term equal to zero. This yields two possible values of $w_{1l,t}$ for local optima. The second values satisfying the necessary conditions are -17.14 for $\tau_{t-1}^{PEV1} = 0.3$ and -11.27 for $\tau_{t-1}^{PEV1} = 1.0$.
The expressions for the critical points show that whether these points are smaller or larger than w_{1l}^{min} depends solely on τ_{t-1}^{PEV1}, s, and β.

Since $\frac{\partial^2 F}{\partial \tau_{t-1}^{PEV1} \partial w_{1l,t}}(\tau_{t-1}^{PEV1}, w_{1l,t}) < 0$ for $w_{1l,t} > 0$, we can conclude that

$$\frac{\partial F}{\partial \tau_{t-1}^{PEV1}}(\tau_{t-1}^{PEV1}, w_{1l,t}) > 0 \qquad \text{for} \qquad 0 < w_{1l,t} < w_{1l}^{min} \tag{A.3}$$

$$\frac{\partial F}{\partial \tau_{t-1}^{PEV1}}(\tau_{t-1}^{PEV1}, w_{1l,t}) < 0 \qquad \text{for} \qquad w_{1l,t} > w_{1l}^{min} \tag{A.4}$$

The partial derivative of $F(\tau_{t-1}^{PEV1}, w_{1l,t})$ with respect to $w_{1l,t}$ is

$$\frac{\partial F}{\partial w_{1l,t}}(\tau_{t-1}^{PEV1}, w_{1l,t}) = -(1+\tau_{t-1}^{PEV1})\frac{1}{1+\beta} s\beta^{\frac{\beta}{1+\beta}} \overline{L}_{1l} \cdot (w_{1l,t})^{\frac{1}{1+\beta}-1} + \frac{\beta}{1+\beta}\beta^{\frac{\beta}{1+\beta}} \overline{L}_2 \cdot (w_{1l,t})^{-\frac{\beta}{1+\beta}-1}$$

It is smaller than zero if and only if

$$-(1+\tau_{t-1}^{PEV1})\frac{1}{1+\beta} s\beta^{\frac{\beta}{1+\beta}} \overline{L}_{1l} \cdot (w_{1l,t})^{\frac{1}{1+\beta}-1} + \frac{\beta}{1+\beta}\beta^{\frac{\beta}{1+\beta}} \overline{L}_2 \cdot (w_{1l,t})^{-\frac{\beta}{1+\beta}-1} < 0$$

$$\Leftrightarrow \quad -(1+\tau_{t-1}^{PEV1}) s \overline{L}_{1l} w_{1l,t} + \beta \overline{L}_2 < 0 \tag{A.5}$$

$$\Leftrightarrow \quad w_{1l,t} > \frac{1}{(1+\tau_{t-1}^{PEV1})s}\beta\frac{\overline{L}_2}{\overline{L}_{1l}} \tag{A.6}$$

From (A.6) we can conclude:

$$\frac{\partial F}{\partial w_{1l,t}}(\tau_{t-1}^{PEV1}, w_{1l,t}) = 0 \qquad \text{for} \qquad w_{1l,t} = \frac{1}{(1+\tau_{t-1}^{PEV1})s}\beta\frac{\overline{L}_2}{\overline{L}_{1l}} \tag{A.7}$$

$$\frac{\partial F}{\partial w_{1l,t}}(\tau_{t-1}^{PEV1}, w_{1l,t}) > 0 \qquad \text{for} \qquad 0 < w_{1l,t} < \frac{1}{(1+\tau_{t-1}^{PEV1})s}\beta\frac{\overline{L}_2}{\overline{L}_{1l}} \tag{A.8}$$

$$\frac{\partial F}{\partial w_{1l,t}}(\tau_{t-1}^{PEV1}, w_{1l,t}) < 0 \qquad \text{for} \qquad w_{1l,t} > \frac{1}{(1+\tau_{t-1}^{PEV1})s}\beta\frac{\overline{L}_2}{\overline{L}_{1l}} \tag{A.9}$$

Now we can use the implicit function theorem to show that $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$ decreases in τ_{t-1}^{PEV1}.

The functions $F(\tau_{t-1}^{PEV1}, w_{1l,t})$ and $\frac{\partial F}{\partial w_{1l,t}}(\tau_{t-1}^{PEV1}, w_{1l,t})$ are continuous in $(\tau_{t-1}^{PEV1}, w_{1l,t})$ for $\tau_{t-1}^{PEV1} \geq 0$ and $w_{1l,t} > 0$.[2]

Let $(\tau_{t-1_0}^{PEV1}, w_{1l,t_0})$ be a vector with $\tau_{t-1_0}^{PEV1} \geq 0$, $w_{1l,t_0} > 0$ and $F(\tau_{t-1_0}^{PEV1}, w_{1l,t_0}) = 0$.

Since $\tilde{U}_{1h,t}^{PEV1}(\cdot)$ is U-shaped with exactly one minimizer which is $\tilde{w}_{1l,t}^{PEV1,min_{1h}} = \frac{1}{(1+\tau_{t-1}^{PEV1})s}\beta\frac{\overline{L}_2}{\overline{L}_{1l}}$, we know that for each $\tau_{t-1_0}^{PEV1} \neq \frac{1-s}{s}$ there is exactly one $w_{1l,t_0} \neq w_{1l}^{min}$ that satisfies $F(\tau_{t-1_0}^{PEV1}, w_{1l,t_0}) = 0$ and thus $\tilde{U}_{1h,t}^{PEV1}(w_{1l}^{min}, \tau_{t-1_0}^{PEV1}) = \tilde{U}_{1h,t}^{PEV1}(w_{1l,t_0}, \tau_{t-1_0}^{PEV1})$. If $\tau_{t-1_0}^{PEV1} = \frac{1-s}{s}$, then w_{1l}^{min} and $\tilde{w}_{1l,t}^{PEV1,min_{1h}}$ coincide and $F(\tau_{t-1_0}^{PEV1}, w_{1l,t_0}) = 0$ only holds if $w_{1l,t_0} = w_{1l}^{min}$.

Furthermore, $\frac{\partial F}{\partial w_{1l,t}}(\tau_{t-1}^{PEV1}, w_{1l,t}) \neq 0$ for all $(\tau_{t-1_0}^{PEV1}, w_{1l,t_0})$ except the vector $(\tau_{t-1_0}^{PEV1}, w_{1l,t_0})$ that satisfies $w_{1l,t_0} = \frac{1}{(1+\tau_{t-1_0}^{PEV1})s}\beta\frac{\overline{L}_2}{\overline{L}_{1l}}$ (see equation A.7) and $F(\tau_{t-1_0}^{PEV1}, w_{1l,t_0}) = 0$. But

[2] Obviously, all partial derivatives of these functions exist for $\tau_{t-1}^{PEV1} \geq 0$ and $w_{1l,t} > 0$.

this is only the case if w_{1l}^{min} and the minimizer of $\tilde{U}_{1h,t}^{PEV1}(\cdot)$, $\tilde{w}_{1l,t}^{PEV1,min_{1h}}$, coincide and hence $(\tau_{t-1_0}^{PEV1}, w_{1l,t_0}) = (\frac{1-s}{s}, w_{1l}^{min})$.

Thus, according to the implicit function theorem, there exists for every $(\tau_{t-1_0}^{PEV1}, w_{1l,t_0})$, $\tau_{t-1_0}^{PEV1} \neq \frac{1-s}{s}$ and $w_{1l,t_0} \neq w_{1l}^{min}$ a function $w_{1l,t} = f(\tau_{t-1}^{PEV1})$ in the neighborhood of $(\tau_{t-1_0}^{PEV1}, w_{1l,t_0})$ with $w_{1l,t_0} = f(\tau_{t-1_0}^{PEV1})$ and $F(\tau_{t-1}^{PEV1}, f(\tau_{t-1}^{PEV1})) = 0$.

The total differential of $F(\tau_{t-1}^{PEV1}, f(\tau_{t-1}^{PEV1}))$ always equals zero and thus:

$$\frac{dw_{1l,t}}{d\tau_{t-1}^{PEV1}} = \frac{df}{d\tau_{t-1}^{PEV1}} = -\frac{\partial F/\partial \tau_{t-1}^{PEV1}}{\partial F/\partial w_{1l,t}} \tag{A.10}$$

Note that $w_{1l,t} = f(\tau_{t-1}^{PEV1}) > w_{1l}^{min}$ if and only if $w_{1l,t} = f(\tau_{t-1}^{PEV1}) > \tilde{w}_{1l,t}^{PEV1,min_{1h}} = \frac{1}{(1+\tau_{t-1}^{PEV1})s}\beta\frac{\bar{L}_2}{\bar{L}_{1l}}$, which holds as long as $\tilde{w}_{1l,t}^{PEV1,min_{1h}} > w_{1l}^{min}$, i.e., $\tau_{t-1}^{PEV1} < \frac{1-s}{s}$. The opposite holds for $w_{1l,t} = f(\tau_{t-1}^{PEV1}) < w_{1l}^{min}$. Therefore, from equation (A.10) we obtain with inequalities (A.3), (A.4), (A.8), and (A.9):

$$\frac{df}{d\tau_{t-1}^{PEV1}} < 0 \qquad \text{for} \qquad \tau_{t-1}^{PEV1} \geq 0 \qquad \text{and} \qquad \tau_{t-1}^{PEV1} \neq \frac{1-s}{s} \tag{A.11}$$

We can identify $f(\tau_{t-1}^{PEV1})$ with $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$ for $\tau_{t-1}^{PEV1} \neq \frac{1-s}{s}$. Since $\frac{d\tilde{w}_{1l,t}^{crit,1h}}{d\tau_{t-1}^{PEV1}} < 0$ for all $\tau_{t-1}^{PEV1} \neq \frac{1-s}{s}$, and $\tilde{w}_{1l,t}^{PEV1,min_{1h}}$ converges to w_{1l}^{min} if $\tau_{t-1}^{PEV1} \to \frac{1-s}{s}$, $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu}) \to w_{1l}^{min}$ if $\tau_{t-1}^{PEV1} \to \frac{1-s}{s}$. Since $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu}) = w_{1l}^{min}$ for $\tau_{t-1}^{PEV1} = \frac{1-s}{s}$, $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$ is a continuous function in τ_{t-1}^{PEV1}, $\tau_{t-1}^{PEV1} \geq 0$ and decreases strictly for $\tau_{t-1}^{PEV1} \neq \frac{1-s}{s}$.

Proof of Proposition 7

If $\bar{w}_{1l} < \tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$, the high-skilled workers of sector 1 will vote for w_{1l}^{min}. Since workers of sector 2 vote for w_{1l}^{min} anyway, w_{1l}^{min} is the Condorcet winner in period t independently of the low-skilled workers' choice. Thus, the equilibrium tax rate on which voters base their decision in period $t+1$ is $\tau_t^{PEV1} = 0$. Because of Corollary 1 (i), $\bar{w}_{1l} < \tilde{w}_{1l,t+1}^{crit,1h}(0, \bar{\nu})$ and the high-skilled workers will again vote for w_{1l}^{min} in period $t+1$. The market-clearing wage is now the Condorcet winner for all subsequent periods, since the critical wage level for the high-skilled workers depends on the previous periods' equilibrium tax rate, which is 0 and does not change any more ($\bar{\nu}$ does not change anyway).

This completes the proof for (i).

To prove (ii), we consider the vectors ν that make up the set $\mathcal{M}^h$. The parameter vector ν is in $\mathcal{M}^h$ if the following holds:

1. $\tilde{w}_{1l,t}^{crit,1l}(\nu) > \tilde{w}_{1l,t}^{crit,1h}(\nu) \quad \wedge \quad \tilde{w}_{1l,t}^{crit,1l}(\nu) \leq w_{1l}^{min}$, or
2. $\tilde{w}_{1l,t}^{crit,1l}(\nu) \leq \tilde{w}_{1l,t}^{crit,1h}(\nu)$

In the first case, $\bar{w}_{1l}$ is larger than $\tilde{w}_{1l,t}^{crit,1l}(\tau_{t-1}^{PEV1}, \bar{\nu})$ and $\tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$ because $\bar{w}_{1l} > w_{1l}^{min}$. Therefore, $\bar{w}_{1l}$ is the Condorcet winner in period t. In the second case, $\bar{w}_{1l}$ is also at least as large as both critical wage levels, since $\bar{w}_{1l} \geq \tilde{w}_{1l,t}^{crit,1h}(\tau_{t-1}^{PEV1}, \bar{\nu})$ and thus, $\bar{w}_{1l}$ is set as minimum wage. For each case, the Condorcet winner in period $t+1$ is determined on the basis of $\tau_{\bar{w}_{1l}}$. Because of Corollary 1 (ii), we know that $\bar{w}_{1l} > \tilde{w}_{1l,t}^{crit,1h}(\tau_{\bar{w}_{1l}}, \tilde{\nu})$.[3] But if $(\tau_{\bar{w}_{1l}}, \bar{\nu}) \in \mathcal{M}^h$, the same arguments as in period t hold and $\bar{w}_{1l}$ is the Condorcet winner not only in $t+1$, but also in all subsequent periods, since $\nu = (\tau_{\bar{w}_{1l}}, \bar{\nu})$ for all subsequent periods.

[3] Note that τ_{t-1}^{PEV1} cannot exceed $\tau_{\bar{w}_{1l}}$ because a minimum wage that would "produce" a τ_{t-1}^{PEV1} exceeding $\tau_{\bar{w}_{1l}}$ would have to be larger than $\bar{w}_{1l}$, since the equilibrium tax rate strictly increases in w_{1l}. But a minimum wage larger than $\bar{w}_{1l}$ would be ruled out by the constitutional court.

Appendix B

Appendix Part II

B.1 The l-Party's Best Responses

We derive the l-party's best responses by backward induction.

B.1.1 Best Response Proposals

In the first step we have to find out which proposal l should make, given $M's$ strategy. Formally, we have to determine the best response $\sigma_l(\cdot \mid \alpha_l, \imath, \theta)$ for every vector $(\alpha_l, \imath, \theta) \in \mathcal{P}$ (compare with (8.1)).

For the α_l^L-type, if has informed and learned that $\theta = G$, the expected utility is (see (7.6)):

$$
\begin{aligned}
&E\Big[U_l\big(\sigma_l(\cdot \mid \alpha_l^L, i, G), (\sigma_M^{\mathcal{E}})\big)\Big] = \qquad \text{(B.1)}\\
&\sigma_l\big(w_b^G \mid \alpha_l^L, i, G\big)\Big[\sigma_M\left(a \mid w_b^G\right)\left\{B + \underline{c} + \alpha_l^L \Delta c - (2\alpha_l^L - 1) w_b^G \Delta c - k\right\}\\
&+ \left\{1 - \sigma_M(a \mid w_b^G)\right\}\left\{\underline{c} + \alpha_l^L \Delta c - (2\alpha_l^L - 1) w_r^P \Delta c - k\right\}\Big] +\\
&\sigma_l\big(w_s^G \mid \alpha_l^L, i, G\big)\Big[\sigma_M\left(a \mid w_s^G\right)\left\{B + \underline{c} + \alpha_l^L \Delta c - (2\alpha_l^L - 1) w_s^G \Delta c - k\right\}\\
&+ \left\{1 - \sigma_M(a \mid w_s^G)\right\}\left\{\underline{c} + \alpha_l^L \Delta c - (2\alpha_l^L - 1) w_r^P \Delta c - k\right\}\Big] +\\
&\sigma_l\big(w_s^P \mid \alpha_l^L, i, G\big)\Big[\sigma_M\left(a \mid w_s^P\right)\left\{B + \underline{c} + \alpha_l^L \Delta c - (2\alpha_l^L - 1) w_s^P \Delta c - k\right\}\\
&+ \left\{1 - \sigma_M(a \mid w_s^P)\right\}\left\{\underline{c} + \alpha_l^L \Delta c - (2\alpha_l^L - 1) w_r^P \Delta c - k\right\}\Big] +\\
&\sigma_l\big(w_b^P \mid \alpha_l^L, i, G\big)\Big[\sigma_M\left(a \mid w_b^P\right)\left\{B + \underline{c} + \alpha_l^L \Delta c - (2\alpha_l^L - 1) w_b^P \Delta c - k\right\}\\
&+ \left\{1 - \sigma_M(a \mid w_b^P)\right\}\left\{\underline{c} + \alpha_l^L \Delta c - (2\alpha_l^L - 1) w_r^P \Delta c - k\right\}\Big]
\end{aligned}
$$

Rearranging terms and using Definition 6 ($\beta_L := |2\alpha_l^L - 1|$ and $\Delta w^v := |w^v - w_r^P|$) we can simplify (B.1) to

$$E\Big[U_l\big(\sigma_l(\cdot \mid \alpha_l^L, i, G), (\sigma_M^{\mathcal{E}})\big)\Big] = \tag{B.2}$$
$$\sigma_l\big(w_b^G \mid \alpha_l^L, i, G\big)\Big[\sigma_M\left(a \mid w_b^G\right)\left\{B - \beta_L \Delta w_b^G \Delta c\right\} + \underline{c} + \alpha_l^L \Delta c + \beta_L w_r^P \Delta c - k\Big] +$$
$$\sigma_l\big(w_s^G \mid \alpha_l^L, i, G\big)\Big[\sigma_M\left(a \mid w_s^G\right)\left\{B - \beta_L \Delta w_s^G \Delta c\right\} + \underline{c} + \alpha_l^L \Delta c + \beta_L w_r^P \Delta c - k\Big] +$$
$$\sigma_l\big(w_s^P \mid \alpha_l^L, i, G\big)\Big[\sigma_M\left(a \mid w_s^P\right)\left\{B + \beta_L \Delta w_s^P \Delta c\right\} + \underline{c} + \alpha_l^L \Delta c + \beta_L w_r^P \Delta c - k\Big] +$$
$$\sigma_l\big(w_b^P \mid \alpha_l^L, i, G\big)\Big[\sigma_M\left(a \mid w_b^P\right)\left\{B + \beta_L \Delta w_b^P \Delta c\right\} + \underline{c} + \alpha_l^L \Delta c + \beta_L w_r^P \Delta c - k\Big]$$

Equation (B.2) shows that the α_l^L-party will almost always choose to propose the higher regulation level, i.e. $w^{G,o}$ or $w^{P,o}$:

If the α_l^L-party makes a G-proposal and M is willing to accept both a small and a large reform, α_l^L will choose $w^{G,o}$ and not $w^{G,u}$ since $w^{G,u} = \Delta w_b^G > \Delta w_s^G = w^{G,o}$ and $\sigma_M\left(a \mid w_b^G\right) = \sigma_M\left(a \mid w_s^G\right)$ (Assumption 3). If M is only willing to accept one of the two possible G-reforms this one is also denoted by $w^{G,o}$ and is chosen because of Assumption 6: To see this, suppose that Assumption 6 does not hold, such that, for example, $B \leq \Delta w_s^G \Delta c$. Then one cannot exclude a parameter constellation where $B < \beta_L \Delta w_s^G \Delta c$. In this case, and if $\sigma_M\left(a \mid w_s^G\right) > 0$ and $\sigma_M\left(a \mid w_b^G\right) = 0$, then $\left[\sigma_M\left(a \mid w_s^G\right)\left\{B - \beta_L \Delta w_s^G \Delta c\right\}\right] < 0$ and α_l^L would choose w_b^G and not $w_s^G = w^{G,o}$. Only if $\sigma_M\left(a \mid w_b^G\right) = \sigma_M\left(a \mid w_s^G\right) = 0$, is α_l^L indifferent. In all other cases, $w^{G,o}$ is strictly better for α_l^L.

If α_l^L makes a P-proposal, it also always chooses the higher regulation value, i.e. $w^{P,o}$, except in the case of $\sigma_M\left(a \mid w_b^P\right) = \sigma_M\left(a \mid w_s^P\right) = 0$.

Now we can summarize our observations:

(1) Suppose that $\sigma_M\left(a \mid w^v\right) > 0$ for at least one $w^v \in \Pi$. Then the α_l^L-party's best responses are to propose:

$$w^{G,o} \iff$$
$$\sigma_M\left(a \mid w^{G,o}\right)\left\{B - \beta_L \Delta w^{G,o} \Delta c\right\} > \sigma_M\left(a \mid w^{P,o}\right)\left\{B + \beta_L \Delta w^{P,o} \Delta c\right\} \tag{B.3}$$
$$w^{P,o} \iff$$
$$\sigma_M\left(a \mid w^{G,o}\right)\left\{B - \beta_L \Delta w^{G,o} \Delta c\right\} < \sigma_M\left(a \mid w^{P,o}\right)\left\{B + \beta_L \Delta w^{P,o} \Delta c\right\} \tag{B.4}$$
$$w^{G,o} \quad \text{and} \quad w^{P,o} \iff$$
$$\sigma_M\left(a \mid w^{G,o}\right)\left\{B - \beta_L \Delta w^{G,o} \Delta c\right\} = \sigma_M\left(a \mid w^{P,o}\right)\left\{B + \beta_L \Delta w^{P,o} \Delta c\right\} \tag{B.5}$$

(2) Suppose that $\sigma_M\left(a \mid w^v\right) = 0$ for all $w^v \in \Pi$. Then α_l^L is indifferent between proposals, i.e. the α_l^L-party's best responses are $w^{G,u}, w^{G,o}, w^{P,u}$, and $w^{P,o}$.

In the following, we will summarize best responses for a $(\alpha_l, \imath, \theta) \in \mathcal{P}$ by giving best response conditions in the case of (1). (It is trivial that the l-party is indifferent between proposals if $\sigma_M(a \mid w^v) = 0$ for all $w^v \in \Pi$.) According to (B.3), the α_l^L-party's best responses are to play

$$
\begin{aligned}
&w^{G,o} \iff \\
&B\left\{\sigma_M\left(a \mid w^{G,o}\right) - \sigma_M\left(a \mid w^{P,o}\right)\right\} > \beta_L \Delta c \left\{\sigma_M\left(a \mid w^{G,o}\right)\Delta w^{G,o} + \sigma_M\left(a \mid w^{P,o}\right)\Delta w^{P,o}\right\} \\
&w^{P,o} \iff \\
&B\left\{\sigma_M\left(a \mid w^{G,o}\right) - \sigma_M\left(a \mid w^{P,o}\right)\right\} < \beta_L \Delta c \left\{\sigma_M\left(a \mid w^{G,o}\right)\Delta w^{G,o} + \sigma_M\left(a \mid w^{P,o}\right)\Delta w^{P,o}\right\} \\
&w^{G,o} \quad \text{or} \quad w^{P,o} \iff \\
&B\left\{\sigma_M\left(a \mid w^{G,o}\right) - \sigma_M\left(a \mid w^{P,o}\right)\right\} = \beta_L \Delta c \left\{\sigma_M\left(a \mid w^{G,o}\right)\Delta w^{G,o} + \sigma_M\left(a \mid w^{P,o}\right)\Delta w^{P,o}\right\}
\end{aligned}
$$

Using Definition 7 we can formulate the following lemma:

Lemma 15
Suppose, that $(\alpha_l, \imath, \theta) = (\alpha_l^L, i, G)$ and $\sigma_M(a \mid w^v) > 0$ for at least one $w^v \in \Pi$. Then the l-party's best responses are to propose

$$
\begin{aligned}
w^{G,o} &\iff B\Delta\sigma_M > \beta_L \Delta c \Sigma_M^o \\
w^{P,o} &\iff B\Delta\sigma_M < \beta_L \Delta c \Sigma_M^o \\
w^{G,o} \quad \text{or} \quad w^{P,o} &\iff B\Delta\sigma_M = \beta_L \Delta c \Sigma_M^o
\end{aligned}
$$

In the case of $(\alpha_l, \imath, \theta) = (\alpha_l^L, i, P)$, we have

$$
\begin{aligned}
&E\Big[U_l\big(\sigma_l(\cdot \mid \alpha_l^L, i, P), (\sigma_M^{\mathcal{E}})\big)\Big] \qquad \text{(B.6)} \\
&= \sum_{w^v \in \Pi} \Bigg\{ \sigma_l\big(w^v \mid \alpha_l^L, i, P\big) \Big[\sigma_M(a \mid w^v)\{B + \underline{c} + w^v \Delta c - k\} + \\
&\{1 - \sigma_M(a \mid w^v)\}\left\{\underline{c} + w_r^P \Delta c - k\right\}\Big] \Bigg\} \\
&= \sum_{w^v \in \{w_b^G, w_s^G\}} \Bigg\{ \sigma_l\big(w^v \mid \alpha_l^L, i, P\big) \Big[\sigma_M(a \mid w^v)\{B - \Delta w^v \Delta c\} + \underline{c} + w_r^P \Delta c - k\Big] \Bigg\} + \\
&\sum_{w^v \in \{w_b^P, w_s^P\}} \Bigg\{ \sigma_l\big(w^v \mid \alpha_l^L, i, P\big) \Big[\sigma_M(a \mid w^v)\{B + \Delta w^v \Delta c\} + \underline{c} + w_r^P \Delta c - k\Big] \Bigg\} \qquad \text{(B.7)}
\end{aligned}
$$

With the same argumentation as above we obtain:

Lemma 16
Suppose that $(\alpha_l, \imath, \theta) = (\alpha_l^L, i, P)$ and $\sigma_M(a \mid w^v) > 0$ for at least one $w^v \in \Pi$. Then

the l-party's best responses are to propose

$$\begin{aligned} w^{G,o} &\iff B\Delta\sigma_M > \Delta c\Sigma_M^o \\ w^{P,o} &\iff B\Delta\sigma_M < \Delta c\Sigma_M^o \\ w^{G,o} \quad \text{or} \quad w^{P,o} &\iff B\Delta\sigma_M = \Delta c\Sigma_M^o \end{aligned}$$

If α_l^L has not informed, it does not know whether $\theta = G$ or $\theta = P$. Thus, the expected utility is the same for α_l^L in both cases. The party assigns probabilities of $\frac{1}{2}$ to each possible state of the world. If we consider equations (B.2) and (B.6) without information costs k we obtain:

$$\begin{aligned} &E\Big[U_l\big(\sigma_l(\cdot \mid \alpha_l^L, \bar{\imath}, \theta), (\sigma_M^{\mathcal{E}})\big)\Big] \qquad \text{(B.8)} \\ &= \sum_{w^v \in \{w_b^G, w_s^G\}} \Bigg\{ \frac{1}{2}\sigma_l\big(w^v \mid \alpha_l^L, \bar{\imath}, \theta\big) \Big[\sigma_M\left(a \mid w^v\right)\{B - \beta_L \Delta w^v \Delta c\} + \underline{c} + \alpha_l^L \Delta c + \beta_L w_r^P \Delta c\Big] + \\ &\frac{1}{2}\sigma_l\big(w^v \mid \alpha_l^L, \bar{\imath}, \theta\big) \Big[\sigma_M\left(a \mid w^v\right)\{B - \Delta w^v \Delta c\} + \underline{c} + w_r^P \Delta c\Big] \Bigg\} + \\ &\sum_{w^v \in \{w_b^P, w_s^P\}} \Bigg\{ \frac{1}{2}\sigma_l\big(w^v \mid \alpha_l^L, \bar{\imath}, \theta\big) \Big[\sigma_M\left(a \mid w^v\right)\{B + \beta_L \Delta w^v \Delta c\} + \underline{c} + \alpha_l^L \Delta c + \beta_L w_r^P \Delta c\Big] + \\ &\frac{1}{2}\sigma_l\big(w^v \mid \alpha_l^L, \bar{\imath}, \theta\big) \Big[\sigma_M\left(a \mid w^v\right)\{B + \Delta w^v \Delta c\} + \underline{c} + w_r^P \Delta c\Big] \Bigg\} = \\ &\qquad = \sum_{w^v \in \{w_b^G, w_s^G\}} \Bigg\{ \sigma_l\big(w^v \mid \alpha_l^L, \bar{\imath}, \theta\big) \Big[\sigma_M\left(a \mid w^v\right)\big\{B - (1-\alpha_l^L)\Delta w^v \Delta c\big\} + \\ &\qquad \underline{c} + \frac{1}{2}\alpha_l^L \Delta c + (1-\alpha_l^L) w_r^P \Delta c\Big] \Bigg\} + \\ &\qquad \sum_{w^v \in \{w_b^P, w_s^P\}} \Bigg\{ \sigma_l\big(w^v \mid \alpha_l^L, \bar{\imath}, \theta\big) \Big[\sigma_M\left(a \mid w^v\right)\big\{B + (1-\alpha_l^L)\Delta w^v \Delta c\big\} + \\ &\qquad \underline{c} + \frac{1}{2}\alpha_l^L \Delta c + (1-\alpha_l^L) w_r^P \Delta c\Big] \Bigg\} \qquad \text{(B.9)} \end{aligned}$$

Thus, in the case of no information we obtain the following lemma:

Lemma 17

Suppose that $(\alpha_l, \imath, \theta) = (\alpha_l^L, \bar{\imath}, \theta)$ *and* $\sigma_M\left(a \mid w^v\right) > 0$ *for at least one* $w^v \in \Pi$. *Then the l-party's best responses are to propose*

$$\begin{aligned} w^{G,o} &\iff B\Delta\sigma_M > (1-\alpha_l^L)\Delta c\Sigma_M^o \\ w^{P,o} &\iff B\Delta\sigma_M < (1-\alpha_l^L)\Delta c\Sigma_M^o \\ w^{G,o} \quad \text{or} \quad w^{P,o} &\iff B\Delta\sigma_M = (1-\alpha_l^L)\Delta c\Sigma_M^o \end{aligned}$$

Now we turn to the other type, the α_l^M-party. Suppose that α_l^M has informed and learned that $\theta = G$, i.e. $(\alpha_l, \imath, \theta) = (\alpha_l^M, i, G)$. We have the same expected utility structure as described in (B.1) and (B.2) with one difference: $(2\alpha_l^M - 1)$ is greater than zero and not smaller than zero as $(2\alpha_l^L - 1)$ is. Therefore, we obtain:

$$
\begin{aligned}
&E\Big[U_l\big(\sigma_l(\cdot \mid \alpha_l^M, i, G), (\sigma_M^{\mathcal{E}})\big)\Big] = \qquad\qquad \text{(B.10)}\\
&\sigma_l\big(w_b^G \mid \alpha_l^M, i, G\big)\Big[\sigma_M\left(a \mid w_b^G\right)\left\{B + \beta_M \Delta w_b^G \Delta c\right\} + \underline{c} + \alpha_l^M \Delta c - \beta_M w_r^P \Delta c - k\Big] +\\
&\sigma_l\big(w_s^G \mid \alpha_l^M, i, G\big)\Big[\sigma_M\left(a \mid w_s^G\right)\left\{B + \beta_M \Delta w_s^G \Delta c\right\} + \underline{c} + \alpha_l^M \Delta c - \beta_M w_r^P \Delta c - k\Big] +\\
&\sigma_l\big(w_s^P \mid \alpha_l^M, i, G\big)\Big[\sigma_M\left(a \mid w_s^P\right)\left\{B - \beta_M \Delta w_s^P \Delta c\right\} + \underline{c} + \alpha_l^M \Delta c - \beta_M w_r^P \Delta c - k\Big] +\\
&\sigma_l\big(w_b^P \mid \alpha_l^M, i, G\big)\Big[\sigma_M\left(a \mid w_b^P\right)\left\{B - \beta_M \Delta w_b^P \Delta c\right\} + \underline{c} + \alpha_l^M \Delta c - \beta_M w_r^P \Delta c - k\Big]
\end{aligned}
$$

Obviously, α_l^M will choose $w^{G,u}$ or $w^{P,u}$. This is on the analogy of α_l^L choosing $w^{G,o}$ or $w^{P,o}$ in the case of information and $\theta = G$. This time Assumption 6 guarantees that $w^{P,u}$ is always chosen as P-proposal and not $w^{P,o}$. We obtain:

Lemma 18
Suppose that $(\alpha_l, \imath, \theta) = (\alpha_l^M, i, G)$ *and* $\sigma_M\left(a \mid w^v\right) > 0$ *for at least one* $w^v \in \Pi$. *Then the l-party's best responses are to propose*

$$
\begin{aligned}
w^{G,u} &\iff B\Delta\sigma_M > -\beta_M \Delta c \Sigma_M^u\\
w^{P,u} &\iff B\Delta\sigma_M < -\beta_M \Delta c \Sigma_M^u\\
w^{G,u} \quad \textit{or} \quad w^{P,u} &\iff B\Delta\sigma_M = -\beta_M \Delta c \Sigma_M^u
\end{aligned}
$$

Note that in the case of $(\alpha_l, \imath, \theta) = (\alpha_l^M, i, G)$, α_l^M always chooses $w^{G,u}$ as long as $\sigma_M^G \geq \sigma_M^P$ and $\sigma_M^G > 0$.

If $(\alpha_l, \imath, \theta) = (\alpha_l^M, i, P)$, M and L would choose the same regulation parameter w, and thus, the type of l (the level of α_l) is not relevant. We can just use equation (B.6) to determine the best response of α_l^M.

Lemma 19
Suppose that $(\alpha_l, \imath, \theta) = (\alpha_l^M, i, P)$ *and* $\sigma_M\left(a \mid w^v\right) > 0$ *for at least one* $w^v \in \Pi$. *Then the l-party's best responses are to propose*

$$
\begin{aligned}
w^{G,o} &\iff B\Delta\sigma_M > \Delta c \Sigma_M^o\\
w^{P,o} &\iff B\Delta\sigma_M < \Delta c \Sigma_M^o\\
w^{G,o} \quad \textit{or} \quad w^{P,o} &\iff B\Delta\sigma_M = \Delta c \Sigma_M^o
\end{aligned}
$$

Equations (B.6) and (B.10) and simple calculations show that, in the case of no information, equation (B.9) holds with α_l^M instead of α_l^L. Therefore, we can conclude:

Lemma 20
Suppose that $(\alpha_l, \imath, \theta) = (\alpha_l^M, \bar{\imath}, \theta)$ *and* $\sigma_M(a \mid w^v) > 0$ *for at least one* $w^v \in \Pi$*. Then the* l*-party's best responses are to propose*

$$\begin{aligned} w^{G,o} &\iff B\Delta\sigma_M > (1-\alpha_l^M)\Delta c\Sigma_M^o \\ w^{P,o} &\iff B\Delta\sigma_M < (1-\alpha_l^M)\Delta c\Sigma_M^o \\ w^{G,o} \quad \text{or} \quad w^{P,o} &\iff B\Delta\sigma_M = (1-\alpha_l^M)\Delta c\Sigma_M^o \end{aligned}$$

B.1.2 Best Response Information Decisions

After deriving best responses for l given $M's$ strategy and $l's$ information decision, we can now determine under which conditions l actually does inform (compare with condition (8.2)). In the following, we will assume that each type of l chooses the higher value of w in the case of indifference. As will be discussed in Section 10.7, this has no substantial effects on the results of our analysis.

First, we analyze the information decision of α_l^L. Considering Lemmas 15 to 17 we can distinguish four areas, denoted by LI to LIV, with different pure strategy best responses $\tilde{\sigma}_l^\Pi(\alpha_l^L)$ (see Definition 9):

$$B\Delta\sigma_M > \Delta c\Sigma_M^o \tag{LI}$$
$$\Delta c\Sigma_M^o \geq B\Delta\sigma_M > (1-\alpha_l^L)\Delta c\Sigma_M^o \tag{LII}$$
$$(1-\alpha_l^L)\Delta c\Sigma_M^o \geq B\Delta\sigma_M > \beta_L\Delta c\Sigma_M^o \tag{LIII}$$
$$\beta_L\Delta c\Sigma_M^o \geq B\Delta\sigma_M \tag{LIV}$$

Suppose $\sigma_M^{\mathcal{E}}$ is such that LI holds, then according to Lemmas 15 to 17 the α_l^L-type's best response proposals are $\sigma_l(w^{G,o} \mid \alpha_l^L, i, G) = \sigma_l(w^{G,o} \mid \alpha_l^L, i, P) = \sigma_l(w^{G,o} \mid \alpha_l^L, \bar{\imath}, \theta) = 1$, i.e. $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{G,o}, w^{G,o})$. In this case, α_l^L always proposes $w^{G,o}$. Thus, it will never inform, because information would only have a value if it changed the party's decision. We obtain the following Lemma:

Lemma 21
Suppose that $B\Delta\sigma_M > \Delta c\Sigma_M^o$*. Then the* α_l^L*-type's best response is to play*

$$\begin{aligned} \tilde{\sigma}_l^\Pi(\alpha_l^L) &= (w^{G,o}, w^{G,o}, w^{G,o}) \quad \text{and} \\ \sigma_l(i \mid \alpha_l^L) &= 0 \end{aligned}$$

If condition LII holds with inequality, we have $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o})$. In the case of $B\Delta\sigma_M = \Delta c\Sigma_M^o$, α_l^L is indifferent between $w^{P,o}$ and $w^{G,o}$ if it has informed and learned that $\theta = P$. Then a best response in pure strategies is also $\tilde{\sigma}_l^\Pi(\alpha_l^L) =$

$(w^{G,o}, w^{G,o}, w^{G,o})$. The α_l^L-party will inform if its expected utility with information is greater than its expected utility without information. In general, the expected utility for α_l^L given $\sigma_M^{\mathcal{E}}$ and σ_l^{Π} with $\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o})$ is (see equations (B.2), (B.7), and (B.9))

$$
\begin{aligned}
&E\Big[U_l\big(\sigma_l(\cdot \mid \alpha_l^L), \sigma_l^{\Pi}, \sigma_M^{\mathcal{E}})\big)\Big] = \qquad\qquad (B.11)\\
&\sigma_l(i \mid \alpha_l^L)\Bigg\{\frac{1}{2}\Big[\sigma_M^G\left\{B - \beta_L \Delta w^{G,o}\Delta c\right\} + \underline{c} + \alpha_l^L \Delta c + \beta_L w_r^P \Delta c - k\Big] + \\
&\frac{1}{2}\Big[\sigma_M^P\left\{B + \Delta w^{P,o}\Delta c\right\} + \underline{c} + w_r^P \Delta c - k\Big]\Bigg\} + \\
&\sigma_l(\bar{i} \mid \alpha_l^L)\Big[\sigma_M^G\left\{B - (1-\alpha_l^L)\Delta w^{G,o}\Delta c\right\} + \underline{c} + \frac{1}{2}\alpha_l^L \Delta c + (1-\alpha_l^L) w_r^P \Delta c\Big]
\end{aligned}
$$

Therefore, α_l^L will incur information costs if

$$
\begin{aligned}
&\Bigg\{\frac{1}{2}\Big[\sigma_M^G\left\{B - \beta_L \Delta w^{G,o}\Delta c\right\} + \underline{c} + \alpha_l^L \Delta c + \beta_L w_r^P \Delta c - k\Big] + \\
&\frac{1}{2}\Big[\sigma_M^P\left\{B + \Delta w^{P,o}\Delta c\right\} + \underline{c} + w_r^P \Delta c - k\Big]\Bigg\} > \\
&\Big[\sigma_M^G\left\{B - (1-\alpha_l^L)\Delta w^{G,o}\Delta c\right\} + \underline{c} + \frac{1}{2}\alpha_l^L \Delta c + (1-\alpha_l^L) w_r^P \Delta c\Big] \\
&\Longleftrightarrow \\
&\frac{1}{2}B\left(\sigma_M^G - \sigma_M^P\right) + k < \frac{1}{2}\Delta c\left(\sigma_M^G \Delta w^{G,o} + \sigma_M^P \Delta w^{P,o}\right) \qquad\qquad (B.12)
\end{aligned}
$$

Note, that condition (B.12) also determines the α_l^L-type's information decision if $B\Delta\sigma_M = \Delta c \Sigma_M^o$. In this case, α_l^L is indifferent between $w^{P,o}$ and $w^{G,o}$ if $\imath = i$ and $\theta = P$. Therefore, the expression $\Big[\sigma_M^P\left\{B + \Delta w^{P,o}\Delta c\right\} + \underline{c} + w_r^P \Delta c - k\Big]$ in (B.11) can be used to derive the information condition even if α_l^L plays $w^{G,o}$ with a certain probability. This is because, in the case of indifference, $\Big[\sigma_M^P\left\{B + \Delta w^{P,o}\Delta c\right\} + \underline{c} + w_r^P \Delta c - k\Big]$ equals $\Big[\sigma_M^G\left\{B - \Delta w^{G,o}\Delta c\right\} + \underline{c} + w_r^P \Delta c - k\Big]$ or any mixture between both.

We find that α_l^L will never inform if $B\Delta\sigma_M = \Delta c \Sigma_M^o$ since $\frac{1}{2}B\Delta\sigma_M = \frac{1}{2}\Delta c \Sigma_M^o$ and thus $\frac{1}{2}B\Delta\sigma_M + k > \frac{1}{2}\Delta c \Sigma_M^o$ as $k > 0$.

We summarize our observations in the following lemma:

Lemma 22
Suppose that $B\Delta\sigma_M = \Delta c \Sigma_M^o$ and $\sigma_M(a \mid w^v) > 0$ for at least one $w^v \in \Pi$. Then the α_l^L-type's best response is to play

$$
\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o}) \quad \textit{or} \quad \tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{G,o}, w^{G,o}, w^{G,o}) \quad \textit{and}
$$
$$
\sigma_l(i \mid \alpha_l^L) = 0
$$

Suppose that $\Delta c\Sigma_M^o > B\Delta\sigma_M > (1-\alpha_l^L)\Delta c\Sigma_M^o$. Then the α_l^L-type's best response is to play

$$\begin{aligned}\tilde{\sigma}_l^\Pi(\alpha_l^L) &= (w^{G,o}, w^{P,o}, w^{G,o}) \quad \textit{and}\\ \sigma_l(i \mid \alpha_l^L) &= 1 \quad \textit{if} \quad \tfrac{1}{2}B\Delta\sigma_M + k < \tfrac{1}{2}\Delta c\Sigma_M^o\\ \sigma_l(i \mid \alpha_l^L) &= 0 \quad \textit{if} \quad \tfrac{1}{2}B\Delta\sigma_M + k > \tfrac{1}{2}\Delta c\Sigma_M^o\\ \sigma_l(i \mid \alpha_l^L) &\in [0,1] \quad \textit{if} \quad \tfrac{1}{2}B\Delta\sigma_M + k = \tfrac{1}{2}\Delta c\Sigma_M^o\end{aligned}$$

If condition LIII holds with inequality, we have $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o})$. In the case of indifference, a best response can also be $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o})$. In the same lines of argumentation as above and using (B.2), (B.7), and (B.9) we observe that α_l^L informs if

$$\begin{aligned}&\Bigg\{\frac{1}{2}\Big[\sigma_M^G\left\{B - \beta_L\Delta w^{G,o}\Delta c\right\} + \underline{c} + \alpha_l^L\Delta c + \beta_L w_r^P\Delta c - k\Big] +\\ &\frac{1}{2}\Big[\sigma_M^P\left\{B + \Delta w^{P,o}\Delta c\right\} + \underline{c} + w_r^P\Delta c - k\Big]\Bigg\} >\\ &\Big[\sigma_M^P\left\{B + (1-\alpha_l^L)\Delta w^{P,o}\Delta c\right\} + \underline{c} + \frac{1}{2}\alpha_l^L\Delta c + (1-\alpha_l^L)w_r^P\Delta c\Big]\\ &\Longleftrightarrow\\ &\frac{1}{2}B\left(\sigma_M^G - \sigma_M^P\right) - k > \left(\frac{1}{2} - \alpha_l^L\right)\Delta c\left(\sigma_M^G\Delta w^{G,o} + \sigma_M^P\Delta w^{P,o}\right) \qquad \text{(B.13)}\end{aligned}$$

We obtain the following lemma:

Lemma 23
Suppose that $B\Delta\sigma_M = (1-\alpha_l^L)\Delta c\Sigma_M^o$ and $\sigma_M(a \mid w^v) > 0$ for at least one $w^v \in \Pi$. Then the α_l^L-type's best response proposals are

$$\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o}) \quad \textit{and} \quad \tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o})$$

Suppose that $(1-\alpha_l^L)\Delta c\Sigma_M^o > B\Delta\sigma_M > \beta_L\Delta c\Sigma_M^o$. Then the α_l^L-type's best response proposal is

$$\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o})$$

In both cases, the best response information decisions are

$$\begin{aligned}\sigma_l(i \mid \alpha_l^L) &= 1 \quad \textit{if} \quad \tfrac{1}{2}B\Delta\sigma_M - k > \left(\tfrac{1}{2} - \alpha_l^L\right)\Delta c\Sigma_M^o\\ \sigma_l(i \mid \alpha_l^L) &= 0 \quad \textit{if} \quad \tfrac{1}{2}B\Delta\sigma_M - k < \left(\tfrac{1}{2} - \alpha_l^L\right)\Delta c\Sigma_M^o\\ \sigma_l(i \mid \alpha_l^L) &\in [0,1] \quad \textit{if} \quad \tfrac{1}{2}B\Delta\sigma_M - k = \left(\tfrac{1}{2} - \alpha_l^L\right)\Delta c\Sigma_M^o\end{aligned}$$

In the case of LIV and if $B\Delta\sigma_M = \beta_L \Delta c \Sigma_M^o$, $\tilde{\sigma}_l^{\Pi}(\alpha_l^L)$ equals $(w^{G,o}, w^{P,o}, w^{P,o})$ or $(w^{P,o}, w^{P,o}, w^{P,o})$. Intuitively, α_l^L will never inform in the case of indifference, because it could play $\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{P,o}, w^{P,o}, w^{P,o})$ and thus information would have no value, as it would not change decisions. This can also be seen from condition (B.13) which would be relevant if α_l^L played $(w^{G,o}, w^{P,o}, w^{P,o})$. Because $B\Delta\sigma_M = \beta_L \Delta c \Sigma_M^o$ we have $\frac{1}{2} B\Delta\sigma_M = (1-\alpha_l^L)\Delta c \Sigma_M^o$, and therefore $\frac{1}{2} B\Delta\sigma_M - k < (1-\alpha_l^L)\Delta c \Sigma_M^o$. Obviously, even in this case α_l^L will not inform. If $B\Delta\sigma_M < \beta_L \Delta c \Sigma_M^o$ then $\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{P,o}, w^{P,o}, w^{P,o})$ and α_l^L will not inform either.

We summarize our considerations in the following lemma:

Lemma 24
Suppose that $B\Delta\sigma_M = \beta_L \Delta c \Sigma_M^o$ and $\sigma_M(a \mid w^v) > 0$ for at least one $w^v \in \Pi$. Then the α_l^L-type's best response proposals are

$$\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{P,o}) \quad \text{and} \quad \tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{P,o}, w^{P,o}, w^{P,o})$$

Suppose that $B\Delta\sigma_M < \beta_L \Delta c \Sigma_M^o$. Then the α_l^L-type's best response proposal is

$$\tilde{\sigma}_l^{\Pi}(\alpha_l^L) = (w^{P,o}, w^{P,o}, w^{P,o})$$

In both cases, the best response information decision is

$$\sigma_l(i \mid \alpha_l^L) = 0$$

Now we turn to the α_l^M-type. According to Lemmas 18 to 20, we can also distinguish four areas depending on $M's$ strategy:

$$\begin{aligned} B\Delta\sigma_M &> \Delta c \Sigma_M^o && \text{(RI)} \\ \Delta c \Sigma_M^o \geq B\Delta\sigma_M &> (1-\alpha_l^M)\Delta c \Sigma_M^o && \text{(RII)} \\ (1-\alpha_l^M)\Delta c \Sigma_M^o \geq B\Delta\sigma_M &> -\beta_M \Delta c \Sigma_M^u && \text{(RIII)} \\ -\beta_M \Delta c \Sigma_M^u \geq B\Delta\sigma_M & && \text{(RIV)} \end{aligned}$$

In the case of $B\Delta\sigma_M > \Delta c \Sigma_M^o$ (RI), α_l^M plays $\tilde{\sigma}_l^{\Pi}(\alpha_l^M) = (w^{G,u}, w^{G,o}, w^{G,o})$. We use equations (B.10), (B.7), and (B.9) with α_l^M instead of α_l^L, to derive under which conditions α_l^M incurs information costs. The α_l^M-type will inform if

$$\left\{\frac{1}{2}\left[\sigma_M^G\left\{B+\beta_M\Delta w^{G,u}\Delta c\right\}+\underline{c}+\alpha_l^M\Delta c-\beta_M w_r^P\Delta c-k\right]+\right.$$
$$\left.\frac{1}{2}\left[\sigma_M^G\left\{B-\Delta w^{G,o}\Delta c\right\}+\underline{c}+w_r^P\Delta c-k\right]\right\}>$$
$$\left[\sigma_M^G\left\{B-(1-\alpha_l^M)\Delta w^{G,o}\Delta c\right\}+\underline{c}+\frac{1}{2}\alpha_l^M\Delta c+(1-\alpha_l^M)w_r^P\Delta c\right]$$
$$\iff$$
$$\alpha_l^M>\frac{1}{2}+\frac{k}{\sigma_M^G\left(w^{G,o}-w^{G,u}\right)\Delta c} \tag{B.14}$$

Note that, if $w^{G,u}=w^{G,o}$, the right hand side of (B.14) goes to infinity and α_l^M will not inform.

Lemma 25
Suppose that $B\Delta\sigma_M>\Delta c\Sigma_M^o$. Then the α_l^M-type's best response is to play

$$\begin{aligned}\tilde{\sigma}_l^{\Pi}(\alpha_l^M)&=(w^{G,u},w^{G,o},w^{G,o})\quad \textit{and}\\ \sigma_l(i\mid\alpha_l^M)=1\quad &\textit{if}\quad \alpha_l^M>\tfrac{1}{2}+\tfrac{k}{\sigma_M^G\Delta c(w^{G,o}-w^{G,u})}\\ \sigma_l(i\mid\alpha_l^M)=0\quad &\textit{if}\quad \alpha_l^M<\tfrac{1}{2}+\tfrac{k}{\sigma_M^G\Delta c(w^{G,o}-w^{G,u})}\\ \sigma_l(i\mid\alpha_l^M)\in[0,1]\quad &\textit{if}\quad \alpha_l^M=\tfrac{1}{2}+\tfrac{k}{\sigma_M^G\Delta c(w^{G,o}-w^{G,u})}\end{aligned}$$

In the next step, we consider RII. In the case of $B\Delta\sigma_M=\Delta c\Sigma_M^o$ we have $\tilde{\sigma}_l^{\Pi}(\alpha_l^M)=(w^{G,u},w^{G,o},w^{G,o})$ or $\tilde{\sigma}_l^{\Pi}(\alpha_l^M)=(w^{G,u},w^{P,o},w^{G,o})$. If $\Delta c\Sigma_M^o>B\Delta\sigma_M>(1-\alpha_l^M)\Delta c\Sigma_M^o$ then the best response is only $\tilde{\sigma}_l^{\Pi}(\alpha_l^M)=(w^{G,u},w^{P,o},w^{G,o})$. The α_l^M-type incurs information costs if (see (B.10), (B.7), and (B.9))

$$\left\{\frac{1}{2}\left[\sigma_M^G\left\{B+\beta_M\Delta w^{G,u}\Delta c\right\}+\underline{c}+\alpha_l^M\Delta c-\beta_M w_r^P\Delta c-k\right]+\right.$$
$$\left.\frac{1}{2}\left[\sigma_M^P\left\{B+\Delta w^{P,o}\Delta c\right\}+\underline{c}+w_r^P\Delta c-k\right]\right\}>$$
$$\left[\sigma_M^G\left\{B-(1-\alpha_l^M)\Delta w^{G,o}\Delta c\right\}+\underline{c}+\frac{1}{2}\alpha_l^M\Delta c+(1-\alpha_l^M)w_r^P\Delta c\right]$$
$$\iff$$
$$\frac{1}{2}B\left(\sigma_M^G-\sigma_M^P\right)+k<\frac{1}{2}\sigma_M^P\Delta w^{P,o}\Delta c+\left[\left(\alpha_l^M-\frac{1}{2}\right)\sigma_M^G\Delta w^{G,u}+\left(1-\alpha_l^M\right)\sigma_M^G\Delta w^{G,o}\right]\Delta c \tag{B.15}$$

We obtain the following lemma:

Lemma 26
Suppose that $B\Delta\sigma_M = \Delta c \Sigma_M^o$ and $\sigma_M(a \mid w^v) > 0$ for at least one $w^v \in \Pi$. Then the α_l^M-type's best response proposals are

$$\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{G,o}, w^{G,o}) \quad \text{and} \quad \tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$$

Suppose that $\Delta c \Sigma_M^o > B\Delta\sigma_M > (1-\alpha_l^M)\Delta c \Sigma_M^o$. Then the α_l^M-type's best response proposal is

$$\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$$

In both cases, the best response information decisions are

$$\sigma_l(i \mid \alpha_l^M) = 1 \quad \text{if}$$
$$\tfrac{1}{2}B\Delta\sigma_M + k < \tfrac{1}{2}\sigma_M^P \Delta c \Delta w^{P,o} + \sigma_M^G \Delta c \left[\left(\alpha_l^M - \tfrac{1}{2}\right)\Delta w^{G,u} + \left(1-\alpha_l^M\right)\Delta w^{G,o}\right]$$
$$\sigma_l(i \mid \alpha_l^M) = 0 \quad \text{if}$$
$$\tfrac{1}{2}B\Delta\sigma_M + k > \tfrac{1}{2}\sigma_M^P \Delta c \Delta w^{P,o} + \sigma_M^G \Delta c \left[\left(\alpha_l^M - \tfrac{1}{2}\right)\Delta w^{G,u} + \left(1-\alpha_l^M\right)\Delta w^{G,o}\right]$$
$$\sigma_l(i \mid \alpha_l^M) \in [0,1] \quad \text{if}$$
$$\tfrac{1}{2}B\Delta\sigma_M + k = \tfrac{1}{2}\sigma_M^P \Delta c \Delta w^{P,o} + \sigma_M^G \Delta c \left[\left(\alpha_l^M - \tfrac{1}{2}\right)\Delta w^{G,u} + \left(1-\alpha_l^M\right)\Delta w^{G,o}\right]$$

In area RIII, we have the following constellations: If $(1-\alpha_l^M)\Delta c \Sigma_M^o = B\Delta\sigma_M$ best response proposals are $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$ and $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{P,o})$. If $(1-\alpha_l^M)\Delta c \Sigma_M^o > B\Delta\sigma_M > -\beta_M \Delta c \Sigma_M^u$ we have $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{P,o})$. The α_l^M-type will inform if (again, see (B.10), (B.7), and (B.9))

$$\begin{aligned}
&\left\{\frac{1}{2}\left[\sigma_M^G\left\{B + \beta_M \Delta w^{G,u}\Delta c\right\} + \underline{c} + \alpha_l^M \Delta c - \beta_M w_r^P \Delta c - k\right] + \right.\\
&\left.\frac{1}{2}\left[\sigma_M^P\left\{B + \Delta w^{P,o}\Delta c\right\} + \underline{c} + w_r^P \Delta c - k\right]\right\} > \\
&\left[\sigma_M^P\left\{B + (1-\alpha_l^M)\Delta w^{P,o}\Delta c\right\} + \underline{c} + \frac{1}{2}\alpha_l^M \Delta c + (1-\alpha_l^M) w_r^P \Delta c\right] \\
&\Longleftrightarrow \\
&\frac{1}{2}B\left(\sigma_M^G - \sigma_M^P\right) - k > \left(\frac{1}{2} - \alpha_l^M\right)\Delta c\left(\sigma_M^G \Delta w^{G,u} + \sigma_M^P \Delta w^{P,o}\right)
\end{aligned} \tag{B.16}$$

Therefore, we can state the following lemma:

Lemma 27
Suppose that $(1-\alpha_l^M)\Delta c\Sigma_M^o = B\Delta\sigma_M$ *and* $\sigma_M(a \mid w^v) > 0$ *for at least one* $w^v \in \Pi$. *Then the* α_l^M*-type's best response proposals are*

$$\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o}) \quad \text{and} \quad \tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{P,o})$$

Suppose that $(1-\alpha_l^M)\Delta c\Sigma_M^o > B\Delta\sigma_M > -\beta_M\Delta c\Sigma_M^u$. *Then the* α_l^M*-type's best response proposal is*

$$\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{P,o})$$

In both cases, the best response information decisions are

$$\begin{aligned}
\sigma_l(i \mid \alpha_l^M) = 1 \quad &\text{if} \quad \tfrac{1}{2}B\Delta\sigma_M - k > \left(\tfrac{1}{2} - \alpha_l^M\right)\Delta c\left(\sigma_M^G \Delta w^{G,u} + \sigma_M^P \Delta w^{P,o}\right)\\
\sigma_l(i \mid \alpha_l^M) = 0 \quad &\text{if} \quad \tfrac{1}{2}B\Delta\sigma_M - k < \left(\tfrac{1}{2} - \alpha_l^M\right)\Delta c\left(\sigma_M^G \Delta w^{G,u} + \sigma_M^P \Delta w^{P,o}\right)\\
\sigma_l(i \mid \alpha_l^M) \in [0,1] \quad &\text{if} \quad \tfrac{1}{2}B\Delta\sigma_M - k = \left(\tfrac{1}{2} - \alpha_l^M\right)\Delta c\left(\sigma_M^G \Delta w^{G,u} + \sigma_M^P \Delta w^{P,o}\right)
\end{aligned}$$

If we are in RIV and $B\Delta\sigma_M = -\beta_M\Delta c\Sigma_M^u$ best response proposals are $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{P,o})$ and $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{P,u}, w^{P,o}, w^{P,o})$. If $B\Delta\sigma_M < -\beta_M\Delta c\Sigma_M^u$ we have $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{P,u}, w^{P,o}, w^{P,o})$. The α_l^M-type will incur information costs if (see (B.10), (B.7), and (B.9))

$$\begin{aligned}
&\Bigg\{\frac{1}{2}\Big[\sigma_M^P\left\{B - \beta_M \Delta w^{P,u}\Delta c\right\} + \underline{c} + \alpha_l^M\Delta c - \beta_M w_r^P \Delta c - k\Big] + \\
&\frac{1}{2}\Big[\sigma_M^P\left\{B + \Delta w^{P,o}\Delta c\right\} + \underline{c} + w_r^P\Delta c - k\Big]\Bigg\} > \\
&\Big[\sigma_M^P\left\{B + (1-\alpha_l^M)\Delta w^{P,o}\Delta c\right\} + \underline{c} + \frac{1}{2}\alpha_l^M\Delta c + (1-\alpha_l^M)w_r^P\Delta c\Big]\\
&\Longleftrightarrow\\
&\alpha_l^M > \frac{1}{2} + \frac{k}{\sigma_M^P\Delta c\left(w^{P,o} - w^{P,u}\right)} \qquad \text{(B.17)}
\end{aligned}$$

Now we can state the following lemma:

Lemma 28
Suppose that $B\Delta\sigma_M = -\beta_M\Delta c\Sigma_M^u$ *and* $\sigma_M(a \mid w^v) > 0$ *for at least one* $w^v \in \Pi$. *Then the* α_l^M*-type's best response proposals are*

$$\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{P,o}) \quad \text{and} \quad \tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{P,u}, w^{P,o}, w^{P,o})$$

Suppose that $B\Delta\sigma_M < -\beta_M\Delta c\Sigma_M^u$. *Then the* α_l^M*-type's best response proposal is*

$$\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{P,u}, w^{P,o}, w^{P,o})$$

In both cases, the best response information decisions are

$$\sigma_l(i \mid \alpha_l^M) = 1 \quad \textit{if} \quad \alpha_l^M > \tfrac{1}{2} + \tfrac{k}{\sigma_M^P \Delta c(w^{P,o} - w^{P,u})}$$
$$\sigma_l(i \mid \alpha_l^M) = 0 \quad \textit{if} \quad \alpha_l^M < \tfrac{1}{2} + \tfrac{k}{\sigma_M^P \Delta c(w^{P,o} - w^{P,u})}$$
$$\sigma_l(i \mid \alpha_l^M) \in [0,1] \quad \textit{if} \quad \alpha_l^M = \tfrac{1}{2} + \tfrac{k}{\sigma_M^P \Delta c(w^{P,o} - w^{P,u})}$$

B.2 Further Proofs and Examples

Proof of Proposition 9

Firstly, we look at the denominator in the expression for

$$\tilde{\mu}_G(w^G) = \frac{\sqrt{\underline{c} + w^G \Delta c} - \sqrt{\underline{c} + w_r^P \Delta c}}{\sqrt{\underline{c} + w^G \Delta c} - \sqrt{\underline{c} + w_r^P \Delta c} - \sqrt{\bar{c} - w^G \Delta c} + \sqrt{\bar{c} - w_r^P \Delta c}}$$

The denominator is zero if

$$\sqrt{\underline{c} + w^G \Delta c} - \sqrt{\bar{c} - w^G \Delta c} = \sqrt{\underline{c} + w_r^P \Delta c} - \sqrt{\bar{c} - w_r^P \Delta c}.$$

This equation only holds if $w^G = w_r^P$. If $w^G < w_r^P$, the left hand side is obviously always smaller than the right hand side, since $\sqrt{\underline{c} + w^G \Delta c}$ is always smaller than $\sqrt{\underline{c} + w_r^P \Delta c}$ and $\sqrt{\bar{c} - w^G \Delta c}$ is always larger than $\sqrt{\bar{c} - w_r^P \Delta c}$. If $w^G > w_r^P$, the opposite holds. Therefore, $\tilde{\mu}_G(w^G)$ is continuous in all possible values of w^G except for w_r^P. The continuity of $\tilde{\mu}_P(w^P)$ in $w^P \in [0,1] \setminus w_r^P$ can be shown analogously.

Now we want to show (iii), i.e.,

$$\frac{\partial \tilde{\mu}_G}{\partial w^G}(w^G) < 0$$

for any $w^G \in [0,1] \setminus w_r^P$.

We make the following definition:

$$\frac{n(w^G)}{m(w^G)} := \tilde{\mu}_G(w^G) = \frac{\sqrt{\underline{c} + w^G \Delta c} - \sqrt{\underline{c} + w_r^P \Delta c}}{\sqrt{\underline{c} + w^G \Delta c} - \sqrt{\underline{c} + w_r^P \Delta c} - \sqrt{\bar{c} - w^G \Delta c} + \sqrt{\bar{c} - w_r^P \Delta c}}$$

Therefore, we can write:

$$\frac{\partial \tilde{\mu}_G}{\partial w^G}(w^G) = \frac{n'(w^G)m(w^G) - n(w^G)m'(w^G)}{(m(w^G))^2} < 0 \quad \Leftrightarrow \quad n'(w^G)m(w^G) - n(w^G)m'(w^G) < 0$$

We obtain:

$$n'(w^G)m(w^G) - n(w^G)m'(w^G) =$$
$$\frac{1}{2}\Delta c \frac{-\bar{c} + \sqrt{(\bar{c} - w^G \Delta c)(\bar{c} - w_r^P \Delta c)} - \underline{c} + \sqrt{(\underline{c} + w^G \Delta c)(\underline{c} + w_r^P \Delta c)}}{\sqrt{(\underline{c} + w^G \Delta c)(\bar{c} - w^G \Delta c)}}$$

Defining

$$f(w^G) := \sqrt{(\bar{c} - w^G\Delta c)(\bar{c} - w_r^P\Delta c)} - \bar{c} \quad \text{and}$$
$$g(w^G) := \underline{c} - \sqrt{(\underline{c} + w^G\Delta c)(\underline{c} + w_r^P\Delta c)} \quad \forall \quad w^G \in [0,1], \quad w_r^P \in [0,1]$$

it holds that:

$$\frac{\partial\tilde{\mu}_G}{\partial w^G}(w^G) < 0 \quad \Leftrightarrow \quad f(w^G) - g(w^G) < 0$$

The functions $f(w^G)$ and $g(w^G)$ have the following characteristics:

$$(i) \quad f(w_r^P) = g(w_r^P) = -w_r^P\Delta c$$
$$(ii) \quad \frac{\partial f}{\partial w^G}(w^G) = -\frac{1}{2}\frac{\Delta c(\bar{c} - w_r^P\Delta c)}{\sqrt{(\bar{c} - w^G\Delta c)(\bar{c} - w_r^P\Delta c)}} < 0 \quad \forall \quad w^G \in [0,1], \quad w_r^P \in [0,1]$$
$$(iii) \quad \frac{\partial g}{\partial w^G}(w^G) = -\frac{1}{2}\frac{\Delta c(\underline{c} + w_r^P\Delta c)}{\sqrt{(\underline{c} + w^G\Delta c)(\underline{c} + w_r^P\Delta c)}} < 0 \quad \forall \quad w^G \in [0,1], \quad w_r^P \in [0,1]$$
$$(iv) \quad \frac{\partial f}{\partial w^G}(w^G = w_r^P) = \frac{\partial g}{\partial w^G}(w^G = w_r^P) = -\frac{1}{2}\Delta c$$
$$(v) \quad \frac{\partial^2 f}{\partial (w^G)^2}(w^G) = -\frac{1}{4}(\Delta c)^2(\bar{c} - w_r^P\Delta c)^2\left[(\bar{c} - w^G\Delta c)(\bar{c} - w_r^P\Delta c)\right]^{-\frac{3}{2}} < 0$$
$$\forall \quad w^G \in [0,1], \quad w_r^P \in [0,1]$$
$$(vi) \quad \frac{\partial^2 g}{\partial (w^G)^2}(w^G) = \frac{1}{4}(\Delta c)^2(\underline{c} + w_r^P\Delta c)^2\left[(\underline{c} + w^G\Delta c)(\underline{c} + w_r^P\Delta c)\right]^{-\frac{3}{2}} > 0$$
$$\forall \quad w^G \in [0,1], \quad w_r^P \in [0,1]$$

From (i) and (iv) it follows that $f(w^G)$ and $g(w^G)$ touch each other in $w^G = w_r^P$. Furthermore, according to (v) and (vi), $f(w^G)$ is concave and $g(w^G)$ convex in $w^G \in [0,1]$. This means that to the right of $w^G = w_r^P$, $g(w^G)$ declines less than $f(w^G)$. To the left of $w^G = w_r^P$, $g(w^G)$ rises more than $f(w^G)$. Therefore, both functions have the same value in $w^G = w_r^P$, but for all other values of $w^G \in [0,1]$, $g(w^G)$ is greater than $f(w^G)$. Hence, we obtain:

$$f(w^G) - g(w^G) < 0 \quad \forall \quad w^G \in [0,1] \setminus w_r^P, \quad w_r^P \in [0,1]$$

■

With the same lines of argumentation, we now show that

$$\frac{\partial\tilde{\mu}_P}{\partial w^P}(w^P) > 0$$

for any $w^P \in [0,1] \setminus w_r^P$.

Using the following definition

$$\frac{k(w^P)}{l(w^P)} := \tilde{\mu}_P(w^P) = \frac{\sqrt{\bar{c} - w_r^P \Delta c} - \sqrt{\bar{c} - w^P \Delta c}}{\sqrt{\underline{c} + w^P \Delta c} - \sqrt{\underline{c} + w_r^P \Delta c} - \sqrt{\bar{c} - w^P \Delta c} + \sqrt{\bar{c} - w_r^P \Delta c}}$$

we obtain

$$\frac{\partial \tilde{\mu}_P}{\partial w^P}(w^P) = \frac{k'(w^P)l(w^P) - k(w^P)l'(w^P)}{(l(w^P))^2} > 0 \quad \Leftrightarrow \quad k'(w^P)l(w^P) - k(w^P)l'(w^P) > 0$$

where

$$\begin{aligned} & k'(w^P)l(w^P) - k(w^P)l'(w^P) = \\ & \frac{1}{2}\Delta c \frac{\bar{c} - \sqrt{(\bar{c} - w^P \Delta c)(\bar{c} - w_r^P \Delta c)} + \underline{c} - \sqrt{(\underline{c} + w^P \Delta c)(\underline{c} + w_r^P \Delta c)}}{\sqrt{(\underline{c} + w^P \Delta c)(\bar{c} - w^P \Delta c)}} \end{aligned}$$

If we define

$$\begin{aligned} r(w^P) &:= \underline{c} - \sqrt{(\underline{c} + w^P \Delta c)(\underline{c} + w_r^P \Delta c)} \quad \text{and} \\ s(w^P) &:= \sqrt{(\bar{c} - w^P \Delta c)(\bar{c} - w_r^P \Delta c)} - \bar{c} \quad \forall \quad w^P \in [0,1], \quad w_r^P \in [0,1] \end{aligned}$$

we obtain

$$\frac{\partial \tilde{\mu}_P}{\partial w^P}(w^P) > 0 \quad \Leftrightarrow \quad r(w^P) - s(w^P) > 0$$

Functions $r(w^P)$ and $s(w^P)$ have the following characteristics:

$$\begin{aligned}
&(i) \quad r(w_r^P) = s(w_r^P) = -w_r^P \Delta c \\
&(ii) \quad \frac{\partial r}{\partial w^P}(w^P) = -\frac{1}{2}\frac{\Delta c(\underline{c} + w_r^P \Delta c)}{\sqrt{(\underline{c} + w^P \Delta c)(\underline{c} + w_r^P \Delta c)}} < 0 \quad \forall \quad w^P \in [0,1], \quad w_r^P \in [0,1] \\
&(iii) \quad \frac{\partial s}{\partial w^P}(w^P) = -\frac{1}{2}\frac{\Delta c(\bar{c} - w_r^P \Delta c)}{\sqrt{(\bar{c} - w^P \Delta c)(\bar{c} - w_r^P \Delta c)}} < 0 \quad \forall \quad w^P \in [0,1], \quad w_r^P \in [0,1] \\
&(iv) \quad \frac{\partial r}{\partial w^P}(w^P = w_r^P) = \frac{\partial s}{\partial w^P}(w^P = w_r^P) = -\frac{1}{2}\Delta c \\
&(v) \quad \frac{\partial^2 r}{\partial (w^P)^2}(w^P) = \frac{1}{4}(\Delta c)^2(\underline{c} + w_r^P \Delta c)^2 \left[(\underline{c} + w^P \Delta c)(\underline{c} + w_r^P \Delta c)\right]^{-\frac{3}{2}} > 0 \\
&\qquad \forall \quad w^P \in [0,1], \quad w_r^P \in [0,1] \\
&(vi) \quad \frac{\partial^2 s}{\partial (w^P)^2}(w^P) = -\frac{1}{4}(\Delta c)^2(\bar{c} - w_r^P \Delta c)^2 \left[(\bar{c} - w^P \Delta c)(\bar{c} - w_r^P \Delta c)\right]^{-\frac{3}{2}} < 0 \\
&\qquad \forall \quad w^G \in [0,1], \quad w_r^P \in [0,1]
\end{aligned}$$

From (i) and (iv) it follows that $r(w^P)$ and $s(w^P)$ touch each other in $w^P = w_r^P$. Furthermore, according to (v) and (vi), $r(w^P)$ is convex and $s(w^P)$ concave in $w^P \in [0,1]$. This means that to the right of $w^P = w_r^P$, $r(w^P)$ declines less than $s(w^P)$. To the left of $w^P = w_r^P$, $r(w^P)$ rises more than $s(w^P)$. Therefore, both functions have the same value in $w^P = w_r^P$, but for all other values of $w^P \in [0,1]$, $r(w^P)$ is greater than $s(w^P)$. Hence, we obtain:

$$r(w^P) - s(w^P) > 0 \quad \forall \quad w^P \in [0,1] \setminus w_r^P, \quad w_r^P \in [0,1]$$

$\blacksquare$

In the next step, we prove (i), and (ii) for $\tilde{\mu}_G(w^G)$, i.e.,

$$(i)\tilde{\mu}_G(w^{G*}) < \frac{1}{2} \quad \text{for any} \quad w^{G*} \in (\frac{1}{2}, w_r^P) \quad \text{if} \quad w_r^P > \frac{1}{2}$$
$$(ii)\tilde{\mu}_G(w^{G*}) > \frac{1}{2} \quad \text{for any} \quad w^{G*} \in [0, w_r^P) \quad \text{if} \quad 0 < w_r^P < \frac{1}{2}$$

Firstly, we need two lemmas:

According to the theorem of L'Hospital, we obtain

$$\lim_{w^G \to w_r^P} \tilde{\mu}_G(w^G) = \frac{n'(w_r^P)}{m'(w_r^P)} = \frac{1}{1 + \sqrt{\frac{\underline{c} + w_r^P \Delta c}{\bar{c} - w_r^P \Delta c}}} \tag{B.18}$$

since $n(w^G)$ and $m(w^G)$ are differentiable in a neighborhood of w_r^P, $n(w_r^P) = m(w_r^P) = 0$, and $m'(w^G) \neq 0$ in a neighborhood of w_r^P. Therefore, we can state the following lemma.

Lemma 29
There exists the right-hand-side and the left-hand-side limit of $\tilde{\mu}_G(w^G)$ at the point w_r^P. Both limits have the same value.

Furthermore, we define $\tilde{\mu}_G(w_r^P)$ as function of w_r^P for a given parameter value w^G:

$$\tilde{\mu}_G(w_r^P) := \frac{\sqrt{\underline{c} + w_r^P \Delta c} - \sqrt{\underline{c} + w^G \Delta c}}{\sqrt{\underline{c} + w_r^P \Delta c} - \sqrt{\underline{c} + w^G \Delta c} - \sqrt{\bar{c} - w_r^P \Delta c} + \sqrt{\bar{c} - w^G \Delta c}} =$$
$$\frac{-\left(\sqrt{\underline{c} + w^G \Delta c} - \sqrt{\underline{c} + w_r^P \Delta c}\right)}{-\left(\sqrt{\underline{c} + w^G \Delta c} - \sqrt{\underline{c} + w_r^P \Delta c} - \sqrt{\bar{c} - w^G \Delta c} + \sqrt{\bar{c} - w_r^P \Delta c}\right)} = \tilde{\mu}_G(w^G)$$

The function $\tilde{\mu}_G(w_r^P)$ has the same form as $\tilde{\mu}_G(w^G)$ but with variable w_r^P instead of w^G. Since $\tilde{\mu}_G(w_r^P) = \tilde{\mu}_G(w^G)$, it follows that

$$\frac{\partial \tilde{\mu}_G}{\partial w_r^P}(w_r^P) = \frac{\partial \tilde{\mu}_G}{\partial w^G}(w^G)$$

and therefore we can state the following lemma.

Lemma 30

$$\frac{\partial \tilde{\mu}_G}{\partial w_r^P}(w_r^P) < 0 \quad \forall \quad w_r^P \in [0,1] \setminus w^G, \quad w^G \in [0,1]$$

Now, we look for the value of w_r^P for which

$$\lim_{w^G \to \frac{1}{2}} \tilde{\mu}_G(w^G) = \frac{1}{2}$$

We can rearrange

$$\lim_{w^G \to \frac{1}{2}} \tilde{\mu}_G(w^G) = \frac{\sqrt{\underline{c} + \frac{1}{2}\Delta c} - \sqrt{\underline{c} + w_r^P \Delta c}}{\sqrt{\underline{c} + \frac{1}{2}\Delta c} - \sqrt{\underline{c} + w_r^P \Delta c} - \sqrt{\bar{c} - \frac{1}{2}\Delta c} + \sqrt{\bar{c} - w_r^P \Delta c}} = \frac{1}{2} \tag{B.19}$$

to

$$\sqrt{\underline{c} + \frac{1}{2}\Delta c} + \sqrt{\bar{c} - \frac{1}{2}\Delta c} = \sqrt{\underline{c} + w_r^P \Delta c} + \sqrt{\bar{c} - w_r^P \Delta c} \tag{B.20}$$

Obviously, equation (B.20) holds if $w_r^P = \frac{1}{2}$. (This follows also from equation (B.18).) As discussed above, we can interpret $\lim_{w^G \to \frac{1}{2}} \tilde{\mu}_G$ (see equation (B.19)) also as function of w_r^P with a given value of w^G. From Lemma 30 we know that $\tilde{\mu}_G(w_r^P)$ decreases when w_r^P increases. Therefore, we can conclude that

$$\lim_{w^G \to \frac{1}{2}} \tilde{\mu}_G(w^G) < \frac{1}{2} \quad \text{for} \quad w_r^P > \frac{1}{2} \quad \text{and}$$
$$\lim_{w^G \to \frac{1}{2}} \tilde{\mu}_G(w^G) > \frac{1}{2} \quad \text{for} \quad w_r^P < \frac{1}{2}$$

Since Lemma 29 holds and $\tilde{\mu}_G(w^G)$ is continuous and strictly decreasing in $w^G \neq w_r^P$, it follows (i), and (ii) for $\tilde{\mu}_G(w^G)$.

■

Now we prove (i), and (ii) for $\tilde{\mu}_P(w^P)$, i.e.,

$$(i)\tilde{\mu}_P(w^{P*}) > \frac{1}{2} \quad \text{for any} \quad w^{P*} \in (w_r^P, 1] \quad \text{if} \quad w_r^P > \frac{1}{2}$$
$$(ii)\tilde{\mu}_P(w^{P*}) < \frac{1}{2} \quad \text{for any} \quad w^{P*} \in (w_r^P, \frac{1}{2}) \quad \text{if} \quad 0 < w_r^P < \frac{1}{2}$$

Using the theorem of L'Hospital we obtain:

$$\lim_{w^P \to w_r^P} \tilde{\mu}_P(w^P) = \frac{k'(w_r^P)}{l'(w_r^P)} = \frac{1}{1 + \sqrt{\frac{\bar{c} - w_r^P \Delta c}{\underline{c} + w_r^P \Delta c}}}$$

This limit is larger than $\frac{1}{2}$ if

$$\begin{aligned}
&\frac{1}{1+\sqrt{\frac{\bar{c}-w_r^P\Delta c}{\underline{c}+w_r^P\Delta c}}} > \frac{1}{2}\\
&\iff \frac{\sqrt{\bar{c}-w_r^P\Delta c}}{\sqrt{\underline{c}+w_r^P\Delta c}} < 1\\
&\iff \bar{c}-w_r^P\Delta c < \underline{c}+w_r^P\Delta c\\
&\iff w_r^P > \frac{1}{2}
\end{aligned}$$

This proves (i) if we consider (iii) and the continuity of $\tilde{\mu}_P(w^P)$ in $w^P \neq w_r^P$. The proof for (ii) is analogous to the proof of (i) and (ii) for $\tilde{\mu}_G(w^G)$ since we can also define a function $\tilde{\mu}_P(w_r^P)$ with a given w^P.

■

Credibility of an equilibrium proposal which is out-off-equilibrium

Suppose the strategy of M, given by $w^{G,u}$, $w^{G,o}$, σ_M^G, $w^{P,u}$, $w^{P,o}$, and σ_M^P, is such that the l-party's best response is to play $\tilde{\sigma}_l^\Pi(\alpha_l^L) = (w^{G,o}, w^{P,o}, w^{G,o})$ and $\tilde{\sigma}_l^\Pi(\alpha_l^M) = (w^{G,u}, w^{P,o}, w^{G,o})$. This is the l-party's best response behavior in Area II. Suppose further that both types of l would not inform in equilibrium, i.e., $\sigma_{iL} = 0$ and $\sigma_{iM} = 0$. Then the proposal $w^{P,o}$ would be out-off-equilibrium. The question arises as to whether we can justify that M assigns only probability $\frac{1}{2}$ to $w^{P,o}$ to represent the correct state of the world, because if l makes a mistake and informs it will propose $w^{P,o}$ only if it learns that $\theta = P$. Nevertheless, if the deviation probability from the equilibrium information decision not to inform is small enough relative to the deviation probability from the equilibrium proposals, the belief of $\frac{1}{2}$ can still be justified by a proper sequence of deviation probabilities. Suppose the sequence $\{\sigma_i^k\}$ represents a sequence of deviation probabilities to inform for both types of l. Let $\{\psi^k\}$ be a sequence of deviation probabilities from $w^{P,o}$ to any other proposal and from $w^{G,o}$ or $w^{G,u}$ to $w^{P,o}$ (Assumption 7 (ii)). Because $\{\sigma_i^k\}$ and $\{\psi^k\}$ are deviation probabilities it holds that:

$$\lim_{k\to\infty} \sigma_i^k = 0 \quad \text{and} \tag{B.21}$$

$$\lim_{k\to\infty} \psi^k = 0 \tag{B.22}$$

Furthermore, we assume that the probability that l wrongly informs is much lower than the probability that l deviates from its equilibrium proposals. We incorporate this in assuming that $\{\psi^k\}$ is asymptotically bigger than $\{\sigma_i^k\}$:

$$\lim_{k\to\infty} \frac{\sigma_i^k}{\psi^k} = 0 \tag{B.23}$$

Now we can calculate the credibility of the out-off-equilibrium $w^{P,o}$-proposal:

$$\mu(\theta = P \mid w^{P,o}) =$$
$$\lim_{k\to\infty} \frac{\lambda\left(\sigma_i^k \frac{1}{2}(1-\psi^k) + (1-\sigma_i^k)\frac{1}{2}\psi^k\right) + (1-\lambda)\left(\sigma_i^k \frac{1}{2}(1-\psi^k) + (1-\sigma_i^k)\frac{1}{2}\psi^k\right)}{\lambda\left(\sigma_i^k(\frac{1}{2}\psi^k + \frac{1}{2}(1-\psi^k)) + (1-\sigma_i^k)\psi^k\right) + (1-\lambda)\left(\sigma_i^k(\frac{1}{2}\psi^k + \frac{1}{2}(1-\psi^k)) + (1-\sigma_i^k)\psi^k\right)}$$

By dividing numerator and denominator by ψ^k we obtain:

$$\mu(\theta = P \mid w^{P,o}) =$$
$$\lim_{k\to\infty} \frac{\lambda\left(\frac{1}{2}\frac{\sigma_i^k}{\psi^k} - \frac{1}{2}\sigma_i^k + (1-\sigma_i^k)\frac{1}{2}\right) + (1-\lambda)\left(\frac{1}{2}\frac{\sigma_i^k}{\psi^k} - \frac{1}{2}\sigma_i^k + (1-\sigma_i^k)\frac{1}{2}\right)}{\lambda\left(\frac{1}{2}\frac{\sigma_i^k}{\psi^k} + (1-\sigma_i^k)\right) + (1-\lambda)\left(\frac{1}{2}\frac{\sigma_i^k}{\psi^k} + (1-\sigma_i^k)\right)}$$

Therefore, together with assumptions (B.21), (B.22), and (B.23) we obtain:

$$\mu(\theta = P \mid w^{P,o}) = \frac{1}{2}$$

We can always find sequences which satisfy (B.21) to (B.23), such that out-off-equilibrium beliefs are $\frac{1}{2}$ for all best response areas and all information structures. Precisely speaking, assumption (B.23) is only necessary when the out-off-equilibrium proposal would be played with information, but information itself is not played in equilibrium. It is easy to verify that in all these cases sequences of deviation probabilities can be constructed that support our result.[1] Actually, depending on $\lim_{k\to\infty}\frac{\sigma_i^k}{\psi^k}$, beliefs could take any value between $\frac{1}{2}$ and 1. For the purpose of our analysis it would suffice to assume that the belief is close enough to $\frac{1}{2}$ that any out-off-equilibrium P-proposal is rejected as well as the large G-reform. In Section 10.7, when we discuss the results of our analysis, we will relax the assumption that out-off-equilibrium beliefs are $\frac{1}{2}$.

Proof to Proposition 13: Non-Existence of Equilibria in Area III with $(\mathbf{ind}, \mathbf{ninfo})$

In Area III, the α_l^L-type is indifferent concerning its information decision if:

$$\frac{1}{2}B\Delta\sigma_M - k = (\frac{1}{2} - \alpha_l^L)\Delta c\Sigma_M^o$$

Therefore, we obtain:

$$k = \frac{1}{2}B\Delta\sigma_M - (\frac{1}{2} - \alpha_l^L)\Delta c\Sigma_M^o \qquad \text{(B.24)}$$

The α_l^M-type informs, if:

$$\frac{1}{2}B\Delta\sigma_M + k < \frac{1}{2}\sigma_M^P\Delta c\Delta w^{P,o} + \sigma_M^G\Delta c\left[\left(\alpha_l^M - \frac{1}{2}\right)\Delta w^{G,u} + \left(1-\alpha_l^M\right)\Delta w^{G,o}\right] \qquad \text{(B.25)}$$

[1] Obviously, credibility is $\frac{1}{2}$ anyway, if the out-off-equilibrium proposal is never played, i.e., in none of the two information states.

If we insert (B.24) in (B.25), we obtain:

$$B\Delta\sigma_M - (\frac{1}{2} - \alpha_l^L)\Delta c\Sigma_M^o < \frac{1}{2}\sigma_M^P \Delta c \Delta w^{P,o} + \sigma_M^G \Delta c \left[\left(\alpha_l^M - \frac{1}{2} \right) \Delta w^{G,u} + \left(1 - \alpha_l^M\right) \Delta w^{G,o} \right] \tag{B.26}$$

In Area III, $B\Delta\sigma_M$ is at the most $(1-\alpha_l^L)\Delta c\Sigma_M^o$. Thus, if α_l^L is indifferent, α_l^M will always inform if:

$$\left((1-\alpha_l^L) - (\frac{1}{2} - \alpha_l^L)\right)\Delta c\Sigma_M^o = \frac{1}{2}\Delta c\Sigma_M^o <$$
$$\frac{1}{2}\sigma_M^P \Delta c \Delta w^{P,o} + \sigma_M^G \Delta c \left[\left(\alpha_l^M - \frac{1}{2} \right) \Delta w^{G,u} + \left(1 - \alpha_l^M\right) \Delta w^{G,o} \right]$$

Because $\sigma_M^G \Delta c \left[\left(\alpha_l^M - \frac{1}{2} \right) \Delta w^{G,u} + \left(1 - \alpha_l^M\right) \Delta w^{G,o} \right] = \frac{1}{2}\sigma_M^G \Delta c \Delta w^{G,o}$ if $\Delta w^{G,u} = \Delta w^{G,o}$, inequality (B.26) holds if $\Delta w^{G,u} > \Delta w^{G,o}$ even if $B\Delta\sigma_M = (1-\alpha_l^L)\Delta c\Sigma_M^o$. The inequality holds all the more if $B\Delta\sigma_M < (1-\alpha_l^L)\Delta c\Sigma_M^o$. If $\Delta w^{G,u} = \Delta w^{G,o}$ and $B\Delta\sigma_M = (1-\alpha_l^L)\Delta c\Sigma_M^o$, the α_l^M-type is indifferent concerning its information decision. In all other cases, α_l^M will inform if α_l^L is indifferent.

Numerical Examples for Area-IIIa-(ind, ind)- and Area-IVb-(ninfo, ind)-equilibria

Suppose we have the following parameter constellation: $\bar{c} = 100$, $\underline{c} = 30$, $B = 80$, $k = 5.207$, $w_r^P = 0.60$, $\lambda = 0.80$, $\alpha_l^L = 0.40$, $\alpha_l^M = 0.60$. Furthermore, suppose that $w_b^G = 0.00$, $w_s^G = 0.55$, and $w_b^P = 1.00$. Then there is an Area-IIIa-(ind, ind)-equilibrium with $w^{G,o*} = w^{G,u*} = 0.55$, ${\sigma_M^G}^* = 1$, $w^{P,o*} = 1.00$, and ${\sigma_M^P}^* = 0.805$. The minimum credibility requirement for the P-proposal is $\tilde{\mu}_P(w^{P,o*}) = 0.585 > 0.556 = \frac{1}{1+\lambda}$. In this equilibrium, the requirement is fulfilled with equality, e.g., for information probabilities ${\sigma_{iL}}^* = 0.200$, and ${\sigma_{iM}}^* = 0.518$. Then we have $\mu(\theta = P \mid w^{P,o*}) = \frac{\lambda + (1-\lambda){\sigma_{iL}}^*}{\lambda(2-{\sigma_{iL}}^*) + (1-\lambda){\sigma_{iM}}^*} = 0.585$ with informational quality 0.632 and $\text{Prob}^{ob}\{G\} = 0.360$. The credibility requirement could also be fulfilled by ${\sigma_{iL}}^* = 0.250$ and ${\sigma_{iM}}^* = 0.236$ with informational quality 0.624 and $\text{Prob}^{ob}\{G\} = 0.400$.

For the following values Area-IVb-$(ninfo, ind)$-equilibria exist: $\bar{c} = 100$, $\underline{c} = 10$, $B = 80$, $k = 10$, $w_r^P = 0.55$, $\lambda = 0.80$, $\alpha_l^L = 0.10$, $\alpha_l^M = 0.65$, $w_b^G = 0.00$, and $w_s^G = 0.51$. The equilibria are characterized by $w^{G,u*} = 0.00$, $w^{G,o*} = 0.51$, ${\sigma_M^G}^* = 1$, and the values listed in Table B.1.

Table B.1: Values for $(ninfo, ind)$-equilibria in Area IVb

$w^{P,o*}$	${\sigma_M^P}^*$	${\sigma_{iM}}^*$	$\mu(\theta = P \mid w^{P,o*}) = \tilde{\mu}_P(w^{P,o*}) = \frac{\lambda+(1-\lambda){\sigma_{iM}}^*}{2\lambda+(1-\lambda){\sigma_{iM}}^*}$	Informational Quality	$\text{Prob}^{ob}\{G\}$
0.62	0.957	0.602	0.535	0.560	0.200
0.65	0.928	0.721	0.541	0.572	0.200
0.70	0.884	0.931	0.552	0.593	0.200

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Appendix C

Part II: Selected Tables and the Game Tree

Table C.1: Best responses for $\sigma_M^G > \sigma_M^P \geq 0$

Area	Conditions for best response proposals $(1-\alpha_l^M) \geq (1-2\alpha_l^L)$ $(1-\alpha_l^M) < (1-2\alpha_l^L)$	Best response proposals $\tilde{\sigma}_l^{\Pi}(\alpha_l^L)$ $\tilde{\sigma}_l^{\Pi}(\alpha_l^M)$	Best response information decisions Conditions for $\sigma_{iL} = 1$ $\sigma_{iM} = 1$
I	$B\Delta\sigma_M > \Delta c\Sigma_M^o$	$(w^{G,o}, w^{G,o}, w^{G,o})$ $(w^{G,u}, w^{G,o}, w^{G,o})$	never $\alpha_l^M > \frac{1}{2} + \frac{k}{\sigma_M^G \Delta c(w^{G,o} - w^{G,u})}$
II	$\Delta c\Sigma_M^o \geq B\Delta\sigma_M > (1-\alpha_l^L)\Delta c\Sigma_M^o$	$(w^{G,o}, w^{P,o}, w^{G,o})$ $(w^{G,u}, w^{P,o}, w^{G,o})$	$\frac{1}{2}B\Delta\sigma_M + k < \frac{1}{2}\Delta c\Sigma_M^o$ $\frac{1}{2}B\Delta\sigma_M + k < \frac{1}{2}\sigma_M^P \Delta c \Delta w^{P,o} +$ $\sigma_M^G \Delta c \left[\left(\alpha_l^M - \frac{1}{2}\right)\Delta w^{G,u} + \left(1-\alpha_l^M\right)\Delta w^{G,o}\right]$
IIIa IIIb	$(1-\alpha_l^L)\Delta c\Sigma_M^o \geq B\Delta\sigma_M > (1-\alpha_l^M)\Delta c\Sigma_M^o$ $(1-\alpha_l^L)\Delta c\Sigma_M^o \geq B\Delta\sigma_M > (1-2\alpha_l^L)\Delta c\Sigma_M^o$	$(w^{G,o}, w^{P,o}, w^{P,o})$ $(w^{G,u}, w^{P,o}, w^{G,o})$	$\frac{1}{2}B\Delta\sigma_M - k > (\frac{1}{2} - \alpha_l^L)\Delta c\Sigma_M^o$ same as in Area II
IVa IVb	$(1-\alpha_l^M)\Delta c\Sigma_M^o \geq B\Delta\sigma_M > (1-2\alpha_l^L)\Delta c\Sigma_M^o$ $(1-2\alpha_l^L)\Delta c\Sigma_M^o \geq B\Delta\sigma_M > (1-\alpha_l^M)\Delta c\Sigma_M^o$	$(w^{G,o}, w^{P,o}, w^{P,o})$ $(w^{G,u}, w^{P,o}, w^{P,o})$ $(w^{P,o}, w^{P,o}, w^{P,o})$ $(w^{G,u}, w^{P,o}, w^{G,o})$	same as in Area III $\frac{1}{2}B\Delta\sigma_M - k > \left(\frac{1}{2} - \alpha_l^M\right)\Delta c\left(\sigma_M^G \Delta w^{G,u} + \sigma_M^P \Delta w^{P,o}\right)$ never same as in Area II
Va Vb	$(1-2\alpha_l^L)\Delta c\Sigma_M^o \geq B\Delta\sigma_M > 0$ $(1-\alpha_l^M)\Delta c\Sigma_M^o \geq B\Delta\sigma_M > 0$	$(w^{P,o}, w^{P,o}, w^{P,o})$ $(w^{G,u}, w^{P,o}, w^{P,o})$	never same as in Area IVa

Table C.2: Best responses for $\sigma_M^P \geq \sigma_M^G$

Area	Conditions for best response proposals	Best response proposals $\tilde{\sigma}_l^{\Pi}(\alpha_l^L)$ $\tilde{\sigma}_l^{\Pi}(\alpha_l^M)$	Best response information decisions Conditions for $\sigma_{iL} = 1$ $\sigma_{iM} = 1$
VI	$0 \geq B\Delta\sigma_M > -(2\alpha_l^M - 1)\Delta c\Sigma_M^u$	$(w^{P,o}, w^{P,o}, w^{P,o})$ $(w^{G,u}, w^{P,o}, w^{P,o})$	never same as in Area IVa
VII	$-(2\alpha_l^M - 1)\Delta c\Sigma_M^u \geq B\Delta\sigma_M$	$(w^{P,o}, w^{P,o}, w^{P,o})$ $(w^{P,u}, w^{P,o}, w^{P,o})$	never $\alpha_l^M > \frac{1}{2} + \frac{k}{\sigma_M^P \Delta c(w^{P,o} - w^{P,u})}$

Table C.3: Credibilities of proposals in potential sequential equilibria of Areas III, IVa, IVb, and V

Area	Information structure of l	Equilibrium strategy of M GI: M accepts both G-reforms		GII: M accepts only the small G-reform		PII/PIII: M accepts only w_s^P / only w_b^P
		$\mu^*(\theta = G \mid w_b^G)$	$\mu^*(\theta = G \mid w_s^G)$	$\mu^*(\theta = G \mid w_b^G)$	$\mu^*(\theta = G \mid w_s^G)$	$\mu^*(\theta = P \mid w^{P,o})$
III	$(ninfo, info)$	1	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{1+\lambda}$
	$(ninfo, ind)$	1	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2-\sigma_{iM}}$ $\in [\frac{1}{2}, 1]$	$\frac{\lambda+(1-\lambda)\sigma_{iM}}{2\lambda+(1-\lambda)\sigma_{iM}}$ $\in [\frac{1}{2}, \frac{1}{1+\lambda}]$
	$(ind, info)$	1	1	$\frac{1}{2}$	1	$\frac{1}{1+\lambda(1-\sigma_{iL})}$ $\in [\frac{1}{1+\lambda}, 1]$
	(ind, ind)	does not exist		$\frac{1}{2}$	$\frac{\lambda\sigma_{iL}+(1-\lambda)}{\lambda\sigma_{iL}+(1-\lambda)(2-\sigma_{iM})}$ $\in [\frac{1}{2}, 1]$	$\frac{\lambda+(1-\lambda)\sigma_{iM}}{\lambda(2-\sigma_{iL})+(1-\lambda)\sigma_{iM}}$ $\in [\frac{1}{2}, 1]$
IVa	$(ninfo, info)$	1	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{1+\lambda}$
	$(ninfo, ind)$	1	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{2-(1-\lambda)\sigma_{iM}}$ $\in [\frac{1}{2}, \frac{1}{1+\lambda}]$
	$(ind, info)$	1	1	$\frac{1}{2}$	1	$\frac{1}{1+\lambda(1-\sigma_{iL})}$ $\in [\frac{1}{1+\lambda}, 1]$
IVb	$(ninfo, info)$	1	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{1+\lambda}$
	$(ninfo, ind)$	1	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2-\sigma_{iM}}$ $\in [\frac{1}{2}, 1]$	$\frac{\lambda+(1-\lambda)\sigma_{iM}}{2\lambda+(1-\lambda)\sigma_{iM}}$ $\in [\frac{1}{2}, \frac{1}{1+\lambda}]$
V	$(ninfo, info)$	1	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{1+\lambda}$
	$(ninfo, ind)$	1	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{2-(1-\lambda)\sigma_{iM}}$ $\in [\frac{1}{2}, \frac{1}{1+\lambda}]$

Table C.4: Potential sequential equilibria of the voting game

Credibility requirements	Areas, information structures, $1 = \sigma_M^G \geq \sigma_M^P \geq 0$	$\text{Prob}^{ob}\{G\}$ (observer's view)
$\tilde{\mu}_P(w^{P,o}) > \frac{1}{1+\lambda}$	I: $(ninfo, ninfo)$, $(ninfo, ind)$, $(ninfo, info)$ $\sigma_M^P = 0$	1
	IIIa/b: $(ind, info)$, (ind, ind) $\sigma_M^P \in (0, 1)$	$(1-\lambda) + \lambda\sigma_{iL}$
	IVa: $(ind, info)$ $\sigma_M^P \in (0, 1)$	
$\tilde{\mu}_P(w^{P,o}) = \frac{1}{1+\lambda}$	IIIa/b, IVa/b, Va/b: $(ninfo, info)$ and all equilibria listed for $\tilde{\mu}_P(w^{P,o}) \neq \frac{1}{1+\lambda}$ with $\sigma_{iL} = 0$ and $\sigma_{iM} = 1$. $\sigma_M^P \in (0, 1)$	$(1-\lambda)$
$\tilde{\mu}_P(w^{P,o}) < \frac{1}{1+\lambda}$	I: $(ninfo, ninfo)$, $(ninfo, ind)$, $(ninfo, info)$ $\sigma_M^P = 0$	1
	IIIa/b, IVb: $(ninfo, ind)$ $\sigma_M^P \in (0, 1)$	$(1-\lambda)$
	IVa, Va/b: $(ninfo, ind)$ $\sigma_M^P \in (0, 1)$	$(1-\lambda)\sigma_{iM}$
	IIIa/b: (ind, ind) $\sigma_M^P \in (0, 1)$	$(1-\lambda) + \lambda\sigma_{iL}$
	VI: $(ninfo, ind)$ $\sigma_M^P = 1$	$(1-\lambda)\sigma_{iM}$
	VI: $(ninfo, info)$ $\sigma_M^P = 1$	$(1-\lambda)$

Informational quality: ex-ante probability for correct policy (agents' view)
$\text{Prob}\{\text{Area I}\} = \frac{1}{2}$ Probabilities for information structures of all other equilibria except those of Area I: $\text{Prob}\{(ninfo, info)\} = \lambda\frac{1}{2} + (1-\lambda)$ $\text{Prob}\{(ninfo, ind)\} = \lambda\frac{1}{2} + (1-\lambda)(\frac{1}{2} + \frac{1}{2}\sigma_{iM})$ $\text{Prob}\{(ind, info)\} = \lambda(\frac{1}{2} + \frac{1}{2}\sigma_{iL}) + (1-\lambda)$ $\text{Prob}\{(ind, ind)\} = \lambda(\frac{1}{2} + \frac{1}{2}\sigma_{iL}) + (1-\lambda)(\frac{1}{2} + \frac{1}{2}\sigma_{iM})$ $\Longrightarrow \frac{1}{2} < \text{Prob}\{(ninfo, ind)\} < \text{Prob}\{(ninfo, info)\} < \text{Prob}\{(ind, info)\}$

Figure C.1: The game tree