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ABSTRACT

General Equilibrium Effects and Voting into a Crisis*

We show that in democracies insufficient recognition of general equilibrium effects can lead to a crisis. We consider a two-sector economy in which a majoritarian political process determines governmental regulation in one sector: a minimum nominal wage. If voters recognize general equilibrium feedbacks, workers across sectors form a majority and will favour market-clearing wages. If voters only take into account direct effects in the regulated sector, workers in the other sector are willing to vote for wage rises in each period since they also reckon with higher real wages for themselves. The political process leads to constantly rising unemployment and tax rates. The resulting crisis may trigger new insights into economic relationships on the part of the voters and may reverse bad times.

JEL Classification: D72, D83, E24 and J30
Keywords: awareness of general equilibrium effects, crises, democracies, rise and fall of market distortions and unemployment

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1 Introduction

In this paper 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 will discuss in section 3. 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 in 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. 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 our paper 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

[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), Giersch (1996), Gersbach and Sheldon (1996), Lindbeck (1996), Oswald (1996), Siebert (1997), Nickell (1997).

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, our paper complements the work of Saint-Paul (2000). 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. The paper is complementary to recent examinations on 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. In this paper we examine how awareness of specific general equilibrium effects impacts on democratic processes.

The paper is organized as follows. In section 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. 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 section 4, the utility functions depending on the minimum wage of the low-skilled 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. In section 5, we interpret the results economically by describing the economic reasoning process of voters under each view. We shed some light on the robustness of our results in section 6 and we conclude in section 7.

2 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:

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

with $\beta < 1$ and

$$q_2 = L_2 \tag{2}$$

Subscripts 1 and 2 denote the first and second sector, respectively. h stands for the 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, i.e., they can only work in one sector. Labor supply is assumed to be inelastic and is given by $\overline{L}_{1l} + \overline{L}_{1h}$ in sector 1 and $\overline{L}_2$ 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]

[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.

[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.

$$u = c_1^{\frac{1}{2}} c_2^{\frac{1}{2}} \tag{3}$$

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:

$$p_2 = 1 \tag{4}$$

The appropriate consumer price index is:

$$p = p_1^{\frac{1}{2}} p_2^{\frac{1}{2}} = p_1^{\frac{1}{2}} \tag{5}$$

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 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:

$$\frac{\overline{L}_f}{\overline{L}_{1l} + \overline{L}_{1h} + \overline{L}_2} < \frac{1}{2} \tag{6}$$

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

2.1 Equations

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:

$$c_1^f = \frac{1}{2} \frac{b_f}{p_1} \tag{7}$$

[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.

$$c_2^f = \frac{1}{2} b_f \tag{8}$$

where $f = 1l, 1h, 2$ refers to the employed workers and $f = un$ refers to the unemployed. The budgets b_f are $w_f + \frac{\pi_1 + \pi_2}{L_{1h} + L_2}$ for $f = 1h, 2$. For the employed low-skilled b_{1l} equals w_{1l} and for $f = un$ we have:

$$b_{un} = s w_{1l} \tag{9}$$

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

$$\pi_1 = p_1 q_1 - w_{1l}(1+\tau)L_{1l} - w_{1h}(1+\tau)L_{1h} \tag{10}$$

$$\pi_2 = q_2 - w_2(1+\tau)L_2 \tag{11}$$

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

$$w_{1l}(1+\tau) = p_1 \beta \Big(\frac{L_{1h}}{L_{1l}}\Big)^{(1-\beta)} \tag{12}$$

$$w_{1h}(1+\tau) = p_1 (1-\beta) \Big(\frac{L_{1l}}{L_{1h}}\Big)^{\beta} \tag{13}$$

$$w_2(1+\tau) = 1 \tag{14}$$

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:

$$L_{1h} = \overline{L}_{1h} \tag{15}$$

$$L_2 = \overline{L}_2 \tag{16}$$

The governmental budget constraint is given by:

[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.

$$(w_{1l}L_{1l} + w_{1h}L_{1h} + w_2 L_2)\tau = \Delta b_{un} \tag{17}$$

where Δ denotes the unemployed work-force:

$$\Delta = \overline{L}_{1l} - L_{1l} \tag{18}$$

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

$$L_{1l}c_2^{1l} + L_{1h}c_2^{1h} + L_2 c_2^2 + \Delta c_2^{un} = q_2 \tag{19}$$

2.2 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 ((12),(13), (14)), the governmental budget constraint ((17),(18)), and the market clearing conditions ((15),(16),(19)). Solving the system yields the following equilibrium solution $E(w_{1l})$:

$$\begin{aligned}
\tau(w_{1l}) &= \frac{s(\beta\overline{L}_2 - w_{1l}\overline{L}_{1l})}{sw_{1l}\overline{L}_{1l} - 2\overline{L}_2} && (20)\\
w_{1h}(w_{1l}) &= \Big(\frac{1-\beta}{1+\tau}\Big)\frac{\overline{L}_2}{\overline{L}_{1h}} && (21)\\
w_2(w_{1l}) &= \frac{1}{1+\tau} && (22)\\
p_1(w_{1l}) &= \Big(\frac{\overline{L}_2}{\overline{L}_{1h}}\Big)^{1-\beta}\Big(\frac{w_{1l}(1+\tau)}{\beta}\Big)^{\beta} && (23)\\
L_{1l}(w_{1l}) &= \beta\overline{L}_2\frac{1}{w_{1l}(1+\tau)} && (24)\\
L_{1h}(w_{1l}) &= \overline{L}_{1h} && (25)\\
L_2(w_{1l}) &= \overline{L}_2 && (26)\\
\Delta(w_{1l}) &= \overline{L}_{1l} - \beta\overline{L}_2\frac{1}{w_{1l}(1+\tau)} && (27)
\end{aligned}$$

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 (24) we determine the lowest possible minimum wage as:

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

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

$$w_{1l}^{min} = \beta \frac{\overline{L}_2}{\overline{L}_{1l}} \quad (28)$$

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

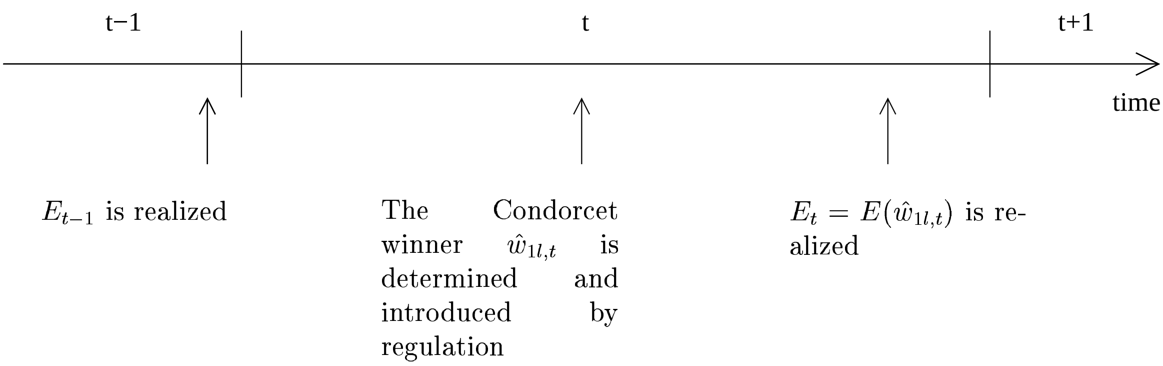
$$w_{1l}^{max} = \frac{2\overline{L}_2}{s\overline{L}_{1l}} \quad (29)$$

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 The Political Process

3.1 Dynamics and Crisis

Figure 1: The political and economic process



In this section we introduce the political process. For that purpose we develop a dynamic framework. There is an infinite number of time periods, indexed by $t = 0, 1, \ldots$. 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

[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.

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 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 is bound to lead to a political crisis with reactions described in 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

[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 (22).

and switch to GEV. Since that third scenario is qualitatively similar to the second scenario, we shall focus on the first two cases.

3.2 Views

We consider two possible scenarios under which voters determine their preferences regarding wage $w_{1l,t}$ and their voting decisions.

3.2.1 General Equilibrium Voting

Under General Equilibrium Voting (GEV), voters consider all general equilibrium effects represented by equations (12)-(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 equilibrium under GEV by E_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 well as $E_t^{GEV} = ... = E_1^{GEV} = E_0^{GEV}$.

3.2.2 Partial Equilibrium Voting

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.

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 (12), (13), (15) and (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 (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 $\tilde{E}_t^{PEV}$ to denote the equilibrium perceived by voters when they determine $\hat{w}_{1l,t}^{PEV}$. To derive $\tilde{E}_t^{PEV}$ we solve the system of 5 equations ((12),(13),(15),(18),(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 $\tilde{\Delta}_t$:

$$\tilde{\tau}_t^{PEV}(w_{1l,t}) = \tau_{t-1}^{PEV} \tag{30}$$

$$\tilde{w}_{1h,t}^{PEV}(w_{1l,t}) = (1-\beta)\frac{\epsilon_t(w_{1l,t})}{\overline{L}_{1h}} \tag{31}$$

$$\tilde{w}_{2,t}^{PEV}(w_{1l,t}) = \frac{1}{1+\tau_{t-1}^{PEV}} \tag{32}$$

$$\tilde{p}_{1,t}^{PEV}(w_{1l,t}) = (1+\tau_{t-1}^{PEV})\Big(\frac{\epsilon_t(w_{1l,t})}{\overline{L}_{1h}}\Big)^{1-\beta}\Big(\frac{w_{1l,t}}{\beta}\Big)^{\beta} \tag{33}$$

$$\tilde{L}_{1l,t}^{PEV}(w_{1l,t}) = \beta\frac{\epsilon_t(w_{1l,t})}{w_{1l,t}} \tag{34}$$

$$\tilde{L}_{1h,t}^{PEV}(w_{1l,t}) = \overline{L}_{1h} \tag{35}$$

$$\tilde{L}_{2,t}^{PEV}(w_{1l,t}) = \overline{L}_{2} \tag{36}$$

$$\tilde{\Delta}_t^{PEV}(w_{1l,t}) = \overline{L}_{1l} - \beta\frac{\epsilon_t(w_{1l,t})}{w_{1l,t}} \tag{37}$$

where

$$\epsilon_t(w_{1l,t}) = \frac{\overline{L}_2 + \tau_{t-1}^{PEV} w_{2,t-1}^{PEV}\overline{L}_2 - s w_{1l,t}\overline{L}_{1l}}{1-s\beta} \tag{38}$$

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:

$$\tilde{w}_{1l,t}^{PEV,max} = \frac{\overline{L}_2 + \tau_{t-1}^{PEV} w_{2,t-1}^{PEV}\overline{L}_2}{s\overline{L}_{1l}} \tag{39}$$

4 Political Equilibria

On the basis of this 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 The Equilibrium under GEV

Using a positive monotone transformation $U = 2\ln u$ of utility function u (see equation (3)), we obtain for the workers of sector 2 in period t:[14]

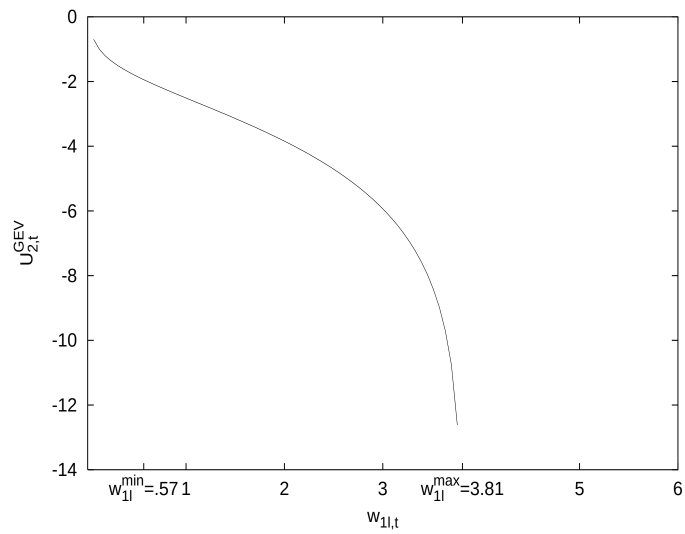
$$\tilde{U}_{2,t}^{GEV} = \ln\Big(\frac{1}{2}\frac{\tilde{w}_{2,t}^{GEV}}{\tilde{p}_{1,t}^{GEV}}\Big) + \ln\Big(\frac{1}{2}\tilde{w}_{2,t}^{GEV}\Big) \tag{40}$$

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 (22) and (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 this paper.

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



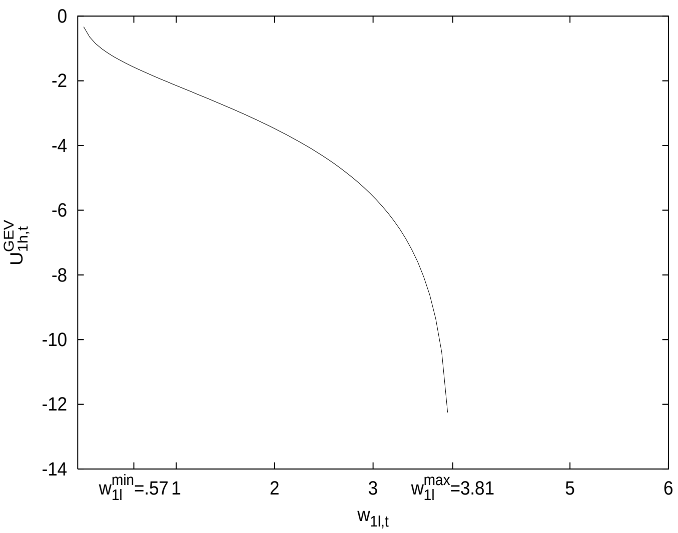
For the high-skilled of sector 1 we obtain:

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

$$U^{GEV}_{1h,t} = \ln\Big(\frac{1}{2}\frac{w^{GEV}_{1h,t}}{p^{GEV}_{1,t}}\Big) + \ln\Big(\frac{1}{2}w^{GEV}_{1h,t}\Big) \tag{41}$$

Because of equations (21) and (23) and the fact that τ^{GEV}_t strictly increases in $w_{1l,t}$, $w^{GEV}_{1h,t}$ strictly decreases and $p^{GEV}_{1,t}$ strictly increases in $w_{1l,t} \in (0, w^{max}_{1l})$. Thus $U^{GEV}_{1h,t}$ strictly decreases in $w_{1l,t} \in (0, w^{max}_{1l})$ and the high-skilled workers of sector 1 will also prefer w^{min}_{1l}.

Figure 3: $U^{GEV}_{1h,t}$ under GEV with $s = 0.75$ and $\beta = 0.4$



We can summarize our observations in the following lemma:

Lemma 1

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

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

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

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:

$$\hat{w}^{GEV}_{1l,t} = w^{min}_{1l} = \beta\frac{\overline{L}_2}{\overline{L}_{1l}} \tag{42}$$

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

Proposition 1
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:

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

This can be simplified to:

$$U_{1l,t}^{GEV} = -2\frac{L_{1l,t}^{GEV}}{\overline{L}_{1l}} \ln(s) + 2\ln(w_{1l,t}) - \ln(p_{1,t}^{GEV}) + 2\ln(s) - 2\ln(2) \qquad (43)$$

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}.

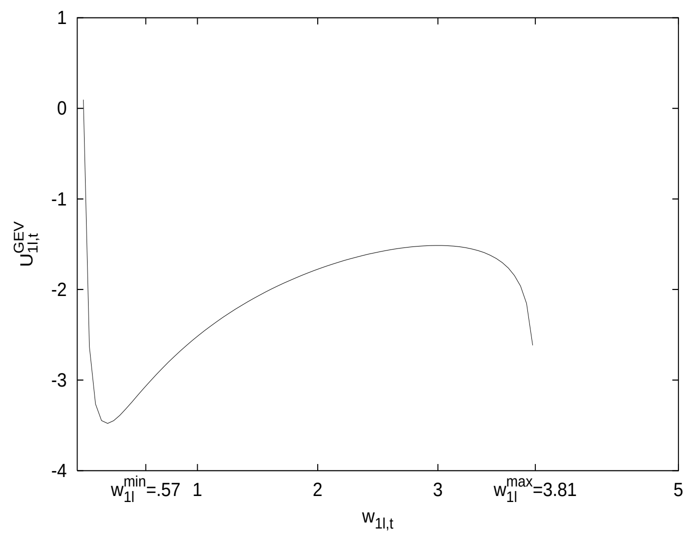
The proof of (i) can be found in the appendix. To illustrate (ii) we can make the following considerations and computations:

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 $\overline{L}_2$. [15] 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

[15] 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.

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 $w_{1l,t} \in (0, w_{1l}^{max})$ [16] and the low- skilled choose w_{1l}^{min}. [17] Figure 4 shows $U_{1l,t}^{GEV}$ for the parameter values given above with an optimal wage exceeding w_{1l}^{min}.

Figure 4: $U_{1l,t}^{GEV}$ with $s = 0.75$ and $\beta = 0.4$



4.2 The Equilibrium under PEV

In the following, we derive the technical results under PEV. In section 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:

[16]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.

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

$$\frac{\partial \tilde{p}_{1,t}^{PEV}}{\partial w_{1l,t}} = \tilde{p}_{1,t}^{PEV}\Big((1-\beta)\frac{-s\overline{L}_{1l}}{\overline{L}_2 + \tau_{t-1}^{PEV} w_{2,t-1}^{PEV}\overline{L}_2 - s w_{1l,t}\overline{L}_{1l}} + \frac{\beta}{w_{1l,t}}\Big) \tag{44}$$

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

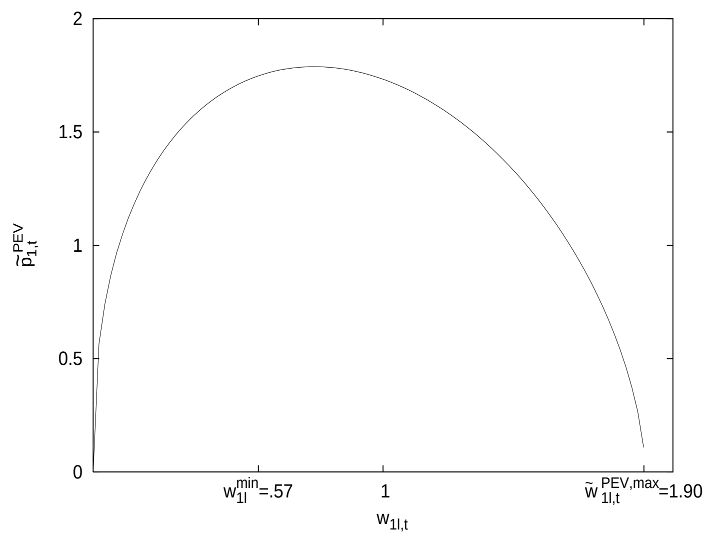
There exists a unique value $\tilde{w}_{1l,t}^{p_1}$ that maximizes $\tilde{p}_{1,t}^{PEV}$ for $w_{1l,t} \in [0, \tilde{w}_{1l,t}^{PEV,max}]$:

$$\tilde{w}_{1l,t}^{p_1} = \beta \tilde{w}_{1l,t}^{PEV,max} = \beta\frac{\overline{L}_2 + \tau_{t-1}^{PEV} w_{2,t-1}^{PEV}\overline{L}_2}{s\overline{L}_{1l}} \tag{45}$$

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

Figure 5 shows $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$ for the case where $\tau_{t-1}^{PEV} = 0$ and thus $w_{2,t-1}^{PEV} = 1$.[18] 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 $\tilde{w}_{1l,t}^{p_1} = 0.76$.

Figure 5: The typical shape of $\tilde{p}_{1,t}^{PEV}(w_{1l,t})$



The utility of workers in sector 2 is:[19]

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

[18] This is the case when there was no regulation in $t-1$.

[19] 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.

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:

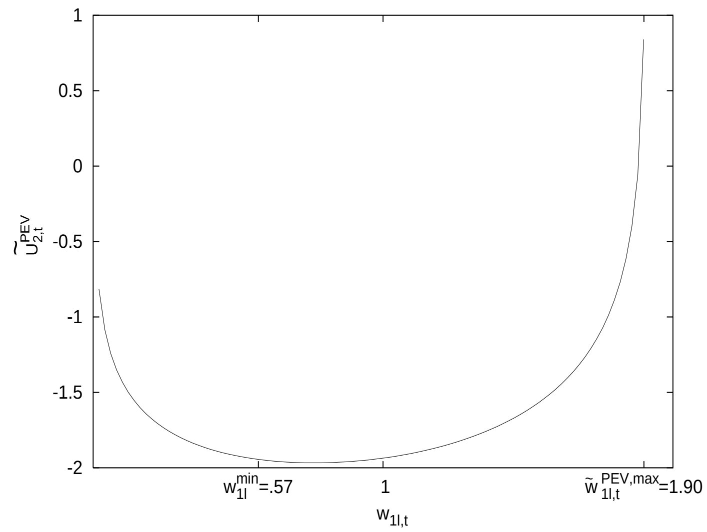
(i) $\lim_{w_{1l,t}\to 0} \tilde{U}_{2,t}^{PEV}(w_{1l,t}) = \infty$ *and* $\lim_{w_{1l,t}\to \tilde{w}_{1l,t}^{PEV,max}} \tilde{U}_{2,t}^{PEV}(w_{1l,t}) = \infty$.

(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 $[w_{1l}^{min}, \tilde{w}_{1l,t}^{PEV,max})$.

Figure 6: $\tilde{U}_{2,t}^{PEV}$ with $\tau_{t-1}^{PEV} = 0$



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:

$$\frac{\tilde{w}_{1h,t}^{PEV}}{\tilde{p}_{1,t}^{PEV}} = \Big(\frac{1-\beta}{1+\tau_{t-1}^{PEV}}\Big)\Big(\frac{\beta}{w_{1l,t}}\Big)^{\beta}\Big(\frac{\epsilon_t(w_{1l,t})}{\overline{L}_{1h}}\Big)^{\beta} \tag{46}$$

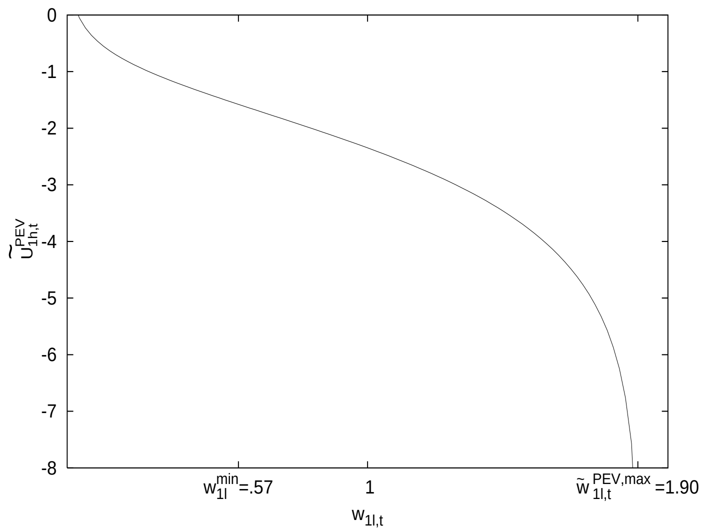
from equations (31) and (46) we can conclude the following:

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

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

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

Figure 7: $\tilde{U}^{PEV}_{1h,t}$ with $\tau^{PEV}_{t-1} = 0$



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

$$\tilde{U}^{PEV}_{1l,t}(w_{1l,t}) = -2\frac{\tilde{L}^{PEV}_{1l,t}}{\overline{L}_{1l}}\ln(s) + \ln(w_{1l,t}) + \ln\Big(\frac{w_{1l,t}}{\tilde{p}^{PEV}_{1,t}}\Big) + 2\ln(s) - 2\ln(2) \qquad (47)$$

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

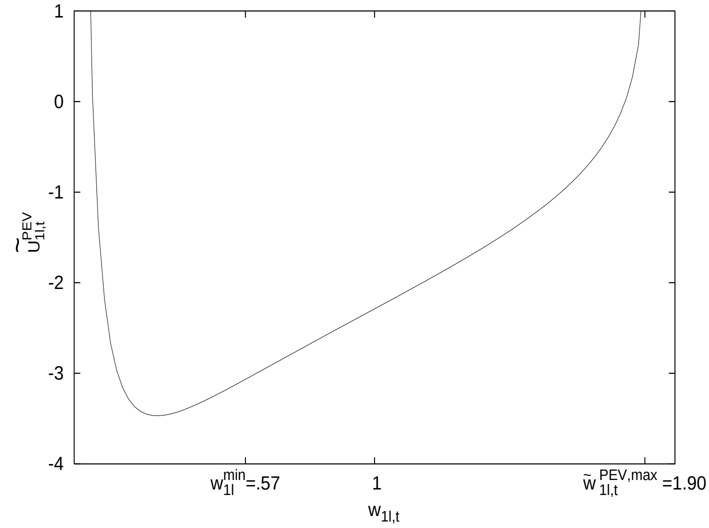
Lemma 6
$\tilde{U}^{PEV}_{1l,t}(w_{1l,t})$ has the following properties:

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

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

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

Figure 8: $\tilde{U}_{1l,t}^{PEV}$ with $\tau_{t-1}^{PEV} = 0$



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 $\hat{w}_{1l,t}^{PEV} = \tilde{w}_{1l,t}^{PEV,max}$. 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

Under PEV, the economy evolves according to:

$$\hat{w}_{1l,t}^{PEV} = \frac{2\overline{L}_2 - \frac{1}{(2-s\beta)^t(1+\tau_r)}\overline{L}_2}{s\overline{L}_{1l}} \tag{48}$$

$$w_{2,t}^{PEV} = \frac{1}{(2-s\beta)^{t+1}(1+\tau_r)} \tag{49}$$

$$\tau_t^{PEV} = (2-s\beta)^{t+1}(1+\tau_r) - 1 \tag{50}$$

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:

$$T = \left\lfloor \frac{\ln\left(\frac{1+\tau_{max}}{1+\tau_r}\right)}{\ln(2 - s\beta)} \right\rfloor \tag{51}$$

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

(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

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

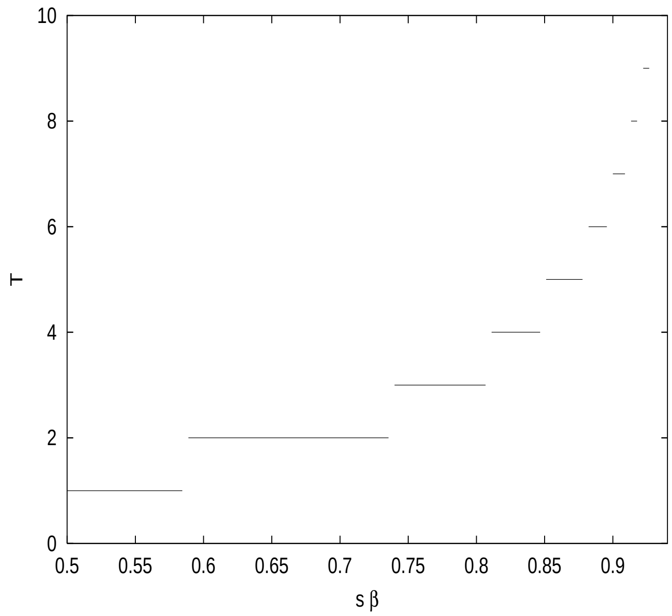
where

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

and the number of unemployed workers is:

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

Figure 9: The collapse period T for $\tau_r = 0$ and $\tau_{max} = 1$



In Figure 9, T is plotted as a function of $s\beta$ (see equation (51)) 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.

4.3 Comparing GEV and 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:

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

Accordingly, unemployment rates satisfy:

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

4.4 Reaction to the Crisis

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 or crosses τ_{max}. 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.

5 Interpretation of the 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.

5.1 General Equilibrium Voting

Under GEV, voters have equations (7) to (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 (19) and the governmental budget constraint (17) are fulfilled simultaneously:

$$L_{1l,t}^{GEV}\frac{b_{1l,t}^{GEV}}{2}+L_{1h,t}^{GEV}\frac{b_{1h,t}^{GEV}}{2}+L_{2,t}^{GEV}\frac{b_{2,t}^{GEV}}{2}+\Delta_t^{GEV}\frac{b_{un,t}^{GEV}}{2} = q_{2,t}^{GEV} \quad (52)$$

$$(w_{1l,t}L_{1l,t}^{GEV}+w_{1h,t}^{GEV}L_{1h,t}^{GEV}+w_{2,t}^{GEV}L_{2,t}^{GEV})\tau_t^{GEV} = \Delta_t^{GEV}b_{un,t}^{GEV} \quad (53)$$

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. [20] 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.[21] 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 can draw the conclusions of Proposition 1 mainly from equations (52) and (53) 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

[20]This follows from the profit maximization condition with respect to L_{1l} (see equation (12))and the fact that the high-skilled labor market always clears and therefore $L_{1h,t}=\overline{L}_{1h}$ in all periods.

[21]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.

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 (52) 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:

$$\left(L_{1l,t}^{GEV}\frac{b_{1l,t}^{GEV}}{2} + L_{1h,t}^{GEV}\frac{b_{1h,t}^{GEV}}{2} + L_{2,t}^{GEV}\frac{b_{2,t}^{GEV}}{2} + \Delta_t^{GEV}\frac{b_{un,t}^{GEV}}{2}\right)/p_{1,t}^{GEV} = q_{1,t}^{GEV} \qquad (54)$$

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 (54) to guarantee market-clearing in the first goods market. Since $q_{2,t}^{GEV}$ remains constant, equation (52) 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 (1) and (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 (52). 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 (53). 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 (52), 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 $sw_{1l,t}$.[22] Then the market for good 2 could only

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

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 (13)). The result is that, because of equation (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 (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 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 (20) to (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}.

5.2 Partial Equilibrium Voting

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 (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 (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 (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.[23] 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) which in turn strictly 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.

6 Robustness

The intuition behind PEV is that voters take a narrow standpoint: They assume that regulations in sector 1 do only affect this sector itself. Sector 2 and tax variables are perceived to stay constant.

There are a variety of alternative formulations of such a narrow viewpoint of voters which are briefly discussed in this section. First, instead of clearing the second goods market in their minds they could also clear the first goods market (View 2). Furthermore, it is conceivable that voters take PEV or View 2 but assume the price for good 1 to be fixed instead of the price for good 2 (View 3 and View 4 respectively).[24]

It can be shown that for all such partial equilibrium views at least two voter groups

[23]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)) and accordingly their real wages would have to be zero.

[24]Stepping outside of the partial equilibrium perspective one could also imagine that voters take relative prices of good 1 and good 2 as constant and expect changes in both sectors.

prefer a minimum wage as high as possible as long as it is economically feasible.[25] Therefore, as soon as voters take a narrower view than under GEV long-run equilibria can occur with high unemployment that are pareto-inefficient. Under GEV we always have full employment.

7 Conclusions

In this paper we give 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 show 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 for 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 fundamental and open question which we hope to answer in subsequent research.

[25] A detailed analysis is available on request. Economic feasibility means that markets clear and taxes are finite.

8 Appendix

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 (23) and (24) and equation (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:

$$\frac{\partial^2\tilde{p}_{1,t}^{PEV}}{\partial(w_{1l,t})^2}(\tilde{w}_{1l,t}^{p_1}) = \tilde{p}_{1,t}^{PEV}\Big((1-\beta)\frac{-(s\overline{L}_{1l})^2}{(\overline{L}_2 + \tau_{t-1}^{PEV}w_{2,t-1}^{PEV}\overline{L}_2 - sw_{1l,t}\overline{L}_{1l})^2} - \frac{\beta}{(w_{1l,t})^2}\Big) < 0$$

Proof of Lemma 6
The utility function of the low-skilled workers of sector 1 is:

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

Furthermore, we obtain:

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

It can be verified that $\lim_{w_{1l,t}\to\tilde{w}^{PEV,max}_{1l,t}} \tilde{L}^{PEV}_{1l,t} = 0$ (see equations (34),(38),(39)) and $\lim_{w_{1l,t}\to\tilde{w}^{PEV,max}_{1l,t}}(w_{1l,t}/\tilde{p}^{PEV}_{1,t}) = \infty$ (see equations (38),(39)). Thus, $\tilde{U}^{PEV}_{1l,t}(w_{1l,t})$ goes to infinity as $w_{1l,t}$ approaches $\tilde{w}^{PEV,max}_{1l,t}$. As $\tilde{U}^{PEV}_{1l,t}(w_{1l,t})$ is a continuous function in $[w^{min}_{1l}, \tilde{w}^{PEV,max}_{1l,t})$, the low-skilled cannot do better with any other wage level than $\tilde{w}^{PEV,max}_{1l,t}$.

To show that $\lim_{w_{1l,t}\to 0}\tilde{U}^{PEV}_{1l,t} = \infty$, is equivalent to show that $\lim_{w_{1l,t}\to 0}\tilde{u}^{PEV}_{1l,t} = \infty$:

$$\begin{aligned}
\tilde{u}^{PEV}_{1l,t} &= \frac{1}{2}\frac{\tilde{L}^{PEV}_{1l,t}}{\overline{L}_{1l}} w_{1l,t}\frac{1}{\sqrt{\tilde{p}^{PEV}_{1,t}}}(1-s) + \frac{1}{2}s w_{1l,t}\frac{1}{\sqrt{\tilde{p}^{PEV}_{1,t}}} \\
&= \frac{1}{2}\frac{1}{\overline{L}_{1l}}\beta\epsilon_t(w_{1l,t})\frac{1}{(1+\tau^{PEV}_{t-1})^{\frac{1}{2}}}\Big(\frac{\overline{L}_{1h}}{\epsilon_t(w_{1l,t})}\Big)^{\frac{1-\beta}{2}}\Big(\frac{\beta}{w_{1l,t}}\Big)^{\frac{\beta}{2}} \\
&\quad + \frac{1}{2}s w^{1-\frac{\beta}{2}}_{1l,t}\frac{1}{(1+\tau^{PEV}_{t-1})^{\frac{1}{2}}}\Big(\frac{\overline{L}_{1h}}{\epsilon_t(w_{1l,t})}\Big)^{\frac{1-\beta}{2}}\beta^{\frac{\beta}{2}}
\end{aligned}$$

As τ^{PEV}_{t-1} is taken as given and $\epsilon_t(w_{1l,t})$ approaches a finite value for $w_{1l,t}\to 0$ (see equation (38)), the first term goes to infinity and the second to zero. Therefore, $\lim_{w_{1l,t}\to 0}\tilde{U}^{PEV}_{1l,t} = \infty$.

Since we obtain a polynomial of degree 2 in $w_{1l,t}$ for $\partial\tilde{U}^{PEV}_{1l,t}/\partial w_{1l,t} = 0$ there could be two local optima in $(0, \tilde{w}^{PEV,max}_{1l,t})$. We can, however, verify that there is only one local optimum - which is a minimizer - in this area because $\tilde{U}^{PEV}_{1l,t}(w_{1l,t})$ goes to infinity for $w_{1l,t}\to 0$ and $w_{1l,t}\to\tilde{w}^{PEV,max}_{1l,t}$, and $\tilde{U}^{PEV}_{1l,t}(w_{1l,t})$ is a continuous function in $(0, \tilde{w}^{PEV,max}_{1l,t})$.

Proof of Proposition 2

Equation (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:

$$\hat{w}^{PEV}_{1l,t+1} = \frac{\overline{L}_2 + \tau^{PEV}_t w^{PEV}_{2,t}\overline{L}_2}{s\overline{L}_{1l}}$$

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 (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 (20) and (22) we find in general:

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

and therefore:

$$w_{2,0}^{PEV} = \frac{2\overline{L}_2 - s\hat{w}_{1l,0}^{PEV}\overline{L}_{1l}}{\overline{L}_2(2-s\beta)} = \frac{1}{(2-s\beta)(1+\tau_r)}$$

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 (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.

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