The Evolution of Social Security System: Pension System vs. Unemployment Insurance*

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Abstract

This paper shows how the social security system evolves as attribution of voters changes. In our setting, policy determination is based on majority voting and the government has two kinds of social security policy; pension and the unemployment insurance. That is, when the workers constitute the majority of voters, pension system is supported and when the unemployed is the majority, the unemployment insurance is adopted. Under such a situation, we show how the contents of the social security system evolves depending on the dynamics of capital accumulation and the unemployment rate, and show the social security system completely vanishes in certain instances.

Keywords: Social Security, Pension System vs. Unemployment Insurance, Majority Voting.

JEL Classification: H55, E61, H53.

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1 Introduction

In Japan, the increase in social security (pension) is vanishingly large as the population ages and fewer babies are born (See fig.1.). On the other hand, the necessity of subsidy to the unemployment (so-called "*NEET*", or "*Working poor*" named in Japan) also remarkably increases, and the cost to such a situation (i.e., unemployment insurance) is also vanishingly large. Under such a circumstance, there may emerge the situation in which the government has to prioritize either pension system or the policy for employment although the government should essentially carry out both policy. This paper models such a situation and show that how the scheme of social security varies as time passes.

The sketch of our model is as follows: First, there two kinds of households; workers and the unemployed. The former hopes the pay-as-you-go (PAYG) type pension system and the latter hops the unemployment insurance. In that regard, its decision is based on the majority voting. As times passes, the ratio of the workers and the unemployment varies, and as a result, the contents of social security also varies. Its choice affects the social welfare. In our setting, policy determination is based on majority voting and the government has two kinds of social security policy; pension and the unemployment insurance. That is, when the workers constitute the majority of voters, pension system is supported and when the unemployed is the majority, unemployment insurance is adopted. Under such a situation, we show how the contents of the social security system evolves depending on the dynamics of capital accumulation and the unemployment rate, and show the social security system vanishes in certain instances.

■Relationship to the Literature Here, let us describe the relationship this paper and the past studies in the following two respects. Since Corneo and Marquardt (2000), which is the first work that models the behavior of the trade union,[1)] there are some studies which models the trade union. For instance, Imoto (2003) extends the model of Corneo and Marquardt (2000)[2)] and show that the existence of trade union may cause the business cycle. Kaas and Thadden (2004) propose the another type of trade union in a similar model, and Ono (2007) focuses on the interaction between pension and unemployment insurance and shows the unemployment dynamics which is dependent on pension. Bräuninger (2005) shows that the unemployment rate is constant under the assumption of endogenous growth model and wage bargaining. In those studies, the kind of social security system is exogenous, with more explanation, how the policy is chosen is not considered. On the other hand, since the seminal paper, Meltzer and Richard (1981) or Hu (1982), there are many studies which focus on the social security system in an overlapping generations model in the context of political economy. These studies typically focus on how the ratio of voters varies as time passes and show how the social security

[1)] See also Galor and Lach (1990) or Bean and Pissarides (1993) which focus on the relationship between unemployment and growth.

[2)] More precisely, Imoto extends the objective function of trade union in the model of Corneo and Marquardt into the CES-type function.

Figure 1　Cost of Pension in Japan: 1996-2005 (source: 93SNA)

system alters. Recently, Hassler, Mora, Storesletten and Zilibotti (2003) and Conde-Ruiz and Galasso (2005) investigate how the contents of the social security system alters depending on change of the wealth distribution. These studies considers two kinds of redistribution scheme, pension and other redistribution policy.

Our paper differs from the above papers in the following two respects. First, unlike the first part, in our model the policy determination is endogenous by introducing the voting model. Second, we focus on the unemployment insurance as an intra-generational redistribution scheme, which differs from the second part.

The rest of this paper is organized as follows: §2 sets up the model and we investigate the dynamics of this economy in the section 3. In the section 4, we show how the contents of social security system alters and show the possibility of annihilation of social security. §5 is the conclusion.

2 The Model

We consider the infinitely-lived economy which consists of households, firms, trade unions, and the government. Our model is similar to that of Kaas and Thadden (2004). Households live two periods: young and old period. The population growth is μ, that is, $N_{t+1} = (1+\mu)N_t$. The structure of the model is depicted in fig. 2.

2.1 Behaviors

2.1.1 Households

Households live two periods in a closed-economy without bequest motive. Dynasties derive utility from public goods as well as consumption and leisure. For simplicity, preferences of the dynasty's cohort that remain alive at t period is described by the following additively separable function:

$$U^i(\cdot) = \ln(c_t^{yi}) + \frac{1}{1+\rho}\ln(c_{t+1}^{oi})$$

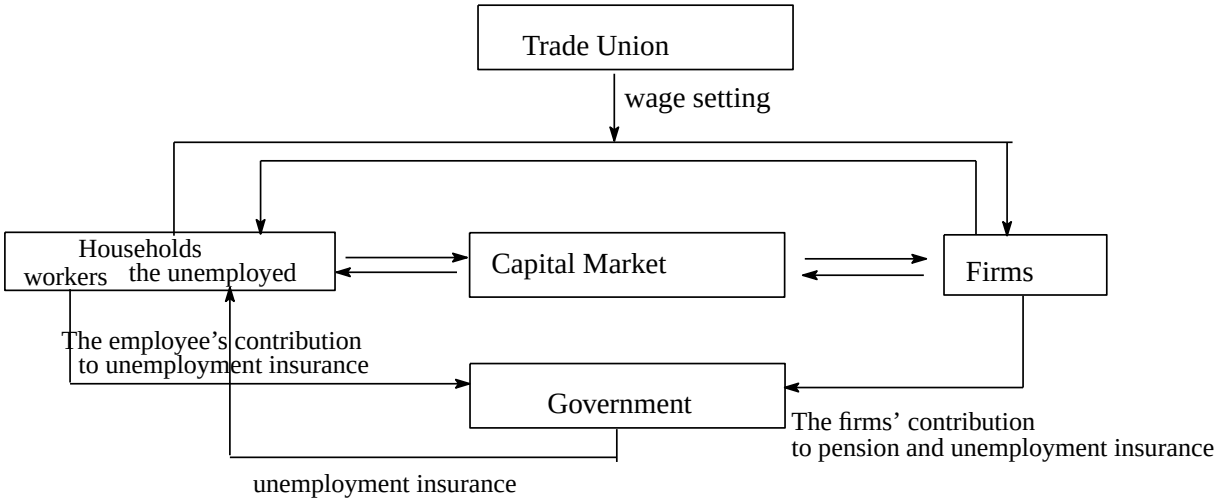

Figure 2 Structure of the model

where ρ denotes the discount factor and $i = \{e, u\}$. e and u denote the employed and the unemployed, respectively. We then assume these solutions (s_t and l_t) are interior.

The budget constraints of the worker and the unemployed are respectively shown as

- Workers:

  When they are young, they work and divide the after-tax labor-income into saving, contribution to pension and consumption. When they are old, they consume saving and pension.

$$c_t^{ye} + s_t + d_t^e = (1 - \tau_t - \theta_{ht}) w_t l_t, \quad c_{t+1}^{oe} = R_{t+1} s_t + d_{t+1}^e, \tag{1}$$

  τ and θ_h are the contribution of the pension unemployment insurance, respectively. Maximization of the utility function under the constraint, eq.(1) yields,

$$s_t^e = \frac{1+\rho}{2+\rho} \left\{ \frac{1}{1+\rho} (1 - \tau_t - \theta_{ht}) w_t - \frac{d_{t+1}^e}{R_t} \right\} \tag{2}$$

- The unemployed:

  When they are young, people receives unemployment insurance (b_t^u) and divide it into saving, contribution to pension and consumption, whereas, When old, they consume saving and pension.

$$d_t^u + c_t^{yu} + s_t = \underbrace{\tau_t w_t l_t}_{b_t^u}, \quad c_{t+1}^{ou} = R_{t+1} s_t + d_{t+1}^u \tag{3}$$

  Maximization of the utility function under the constraint, eq.(3) yields,

$$s_t^u = \frac{1+\rho}{2+\rho} \left\{ \frac{1}{1+\rho} (1 - \tau_t) u_t - \frac{d_{t+1}^u}{R_t} \right\} \tag{4}$$

Whether households works or chooses unemployment depends on the following equation:

$$\text{Labor-income + pension} = \text{Unemployment Insurance}$$

Households determine to work when the RHS of the above equation is larger and not to work when LHS is.

2.1.2 Firms

We assume that factor markets are perfectly competitive and that firms maximize their profits. Labor and capital stock are used for production; production technology yields constant returns to scale. Therefore, production functions are expressed as $Y_t = F(K_t, L_t) : \Re_+^2 \to \Re_+$, where K_t, Y_t, and L_t respectively represent capital stock, and output in aggregate terms and the number of the workers at t period. Firms' profit maximization problem is written as

$$\Pi = F(K_t, L_t) - R_t K_t - (1 + \theta_{ft} + \theta_{wt}) w_t l_t,$$

where R_t, w, θ_f, and θ_w denote the rental price of capital, wage rate, contribution to pension system, and to unemployment insurance, respectively. We then specify the production function as Cob-Douglas case, $F(K_t, L_t) = K_t^{\alpha} L_t^{1-\alpha}$. Then, FOCs are derived as

$$\frac{\partial \Pi}{\partial K_t} = 0 \Leftrightarrow R_t = F_K(K_t, L_t) \tag{5a}$$

$$\frac{\partial \Pi}{\partial L_t} = 0 \Leftrightarrow F_L(K_t, L_t) = (1 + \theta_{ft} + \theta_{wt}) w_t \tag{5b}$$

From these equations,

$$R_t = \alpha \frac{K_t}{L_t} l_t^{\alpha}. \tag{6}$$

2.1.3 Trade Union

The wage is determined by the monopolistic trade union. Following Imoto (2003) who extends the model of Corneo and Marquardt (2000), let us define the behavior of the trade union. The purpose of trade union is to keep both high wage and low unemployment rate at the same time. Now, letting $l_t \equiv \frac{L_t}{N_t}$ denotes the employment rate, the problem of the trade union is:

$$w_t = \arg\max_{w_t} W(\cdot) \equiv \left[\gamma (w_t - \bar{w_t})^{-\sigma} + (1-\gamma)(l_t)^{-\sigma}\right]^{-\frac{1}{\sigma}}, \ \ \sigma \in (-1, \infty), \text{ and } \ \gamma \in (0,1) \tag{7}$$

under the constraint eq. (5b), where $\bar{w_t} = (1-\alpha) l_t^{\alpha} w_t$ denotes the wage at the perfect employment, which is treated as a reference wage. The first order condition is as follows:

$$\gamma (w_t - \bar{w_t})^{-\sigma - 1} + \frac{(1-\gamma)}{\alpha} \left(\frac{(1 + \theta_{ft} + \theta_{wt}) N_t}{(1-\alpha) K_t} \right)^{-\sigma} (w_t)^{\frac{\sigma}{\alpha - 1}} = 0 \tag{8}$$

2.1.4 The Government

The government has two kinds of redistribution scheme: PAYG-type pension system (the inter-generational redistribution scheme) and unemployment insurance (the intra-generational redistribution scheme). The budget constraint under each policy is written as follows:

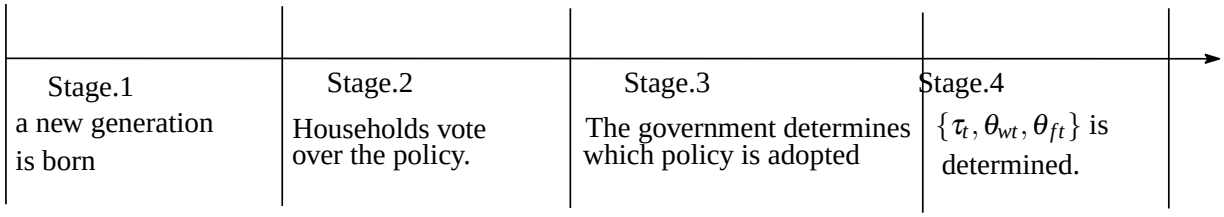

Figure 3 Sequence of Decision Making in t period.

- PAYG-type pension system (the inter-generational redistribution scheme)

$$d_{t+1}L_t + d^u_{t+1}(N - L_t) = \tau_t w_{t+1}L_{t+1} + d^e_t L_t + d^u_t(N - L_{t+1}), \tag{9}$$

  where τ is the contribution to the pension system of the workers.

- unemployment insurance (the intra-generational redistribution scheme)

$$(N - L_t)u_t = \theta_w w_t L_t + \theta_f w_t l_t, \tag{10}$$

  where θ_w is the contribution to the unemployment insurance. The above equation means that the amount of unemployment insurance equals to the sum of contribution of the employed and firms.

Note that which policy is chosen is dependent on the voters' movement. That is, if the young unemployment is the majority, the unemployment insurance is supported, whereas, the old who worked in their youth constitutes the majority, the PAYG-type pension system is supported. So, let us investigate the transitional change of voters in the next section.

2.2 Timing of Decision

Finally, let us summarize the sequence of decision-making (or political process). The sequence of decision making is depicted in fig. 3.

Stage 1. At the tth period, a new generation is born.

Stage 2. Households vote over the policy; pension or unemployment insurance.

Stage 3. The government determines which policy is adopted, based on the result of voting.

Stage 4. After the vote, contribution to pension or unemployment insurance is also determined as $\{\tau_t, \theta_{ft}, \theta_{wt}\}$.

Stage 5. The $t+1$th generation is newly born.

2.3 Market Equilibrium

We formulate equilibrium conditions for each market. Because $\hat{k}_t \equiv \frac{K_t}{N_t} = \frac{K_t}{L_t} \cdot \frac{L_t}{N_t} = k_t l_t$, where N_t is population, we can write this condition as follows:

- Commodity market
$$c_t^{ye} + c_t^{yu} + c_t^{oe} + c_t^{ou} + k_{t+1} l_{t+1} = R_t k_t l_t + w_t l_t \tag{11}$$
- Capital market
In aggregate, $N_t s_t = K_{t+1}$. Therefore,
$$s_t = k_{t+1} l_{t+1} \tag{12}$$
This equation determines the dynamics of capital accumulation in this economy.
- Labor market
In this market, the demand of the labor should equal to the supply of the labor. So, Combining the solution of eq.(5b) and that of eq.(8) yields the labor market equilibrium condition.
$$l_t^d = l_t \tag{13}$$

Finally, let us define the economic equilibrium.

Defnition 1 ***(Economic Equilibrium)*** *An economic equilibrium is a sequence* $\{\tilde{w}_t, l_t, c_t^y, c_t^o, \tilde{R}_{t+1}, g_t\}_{t=0}^{\infty}$ *that accords with the following.*

(i) Given the sequence $\{\tau_t, \theta_{ft}, \theta_{wt}\}_{t=1}^{\infty}$*, each agent (young or elderly) determines the policy variables that maximize their individual utility. That is, the optimal policy variables meet the following maximization problem:*
$$\max \ln(c_t^{yi}) + \frac{1}{1+\rho} \ln(c_{t+1}^{0i}), \quad i \in (e,u)$$
(ii) The budget constraints of pension and unemployment insurance are balanced in each period.
(iii) Finally, the following markets clear.
Commodity Market: Eq. (11)*, Capital Market: Eq.* (12)*, Labor Market: Eq.* (13)

3 Analysis

3.1 Equilibrium Definition

In the spirit of Krusell, Quadrini and Rios-Rull (1997), let us define the equilibrium concept (politico-economic equilibrium[3)]).

[3)] This concept corresponds to so-called Markov-perfect equilibrium. These conditions are dependent on the relationship between the t and $t+1$ period. Therefore, this concept meets the Markov property.

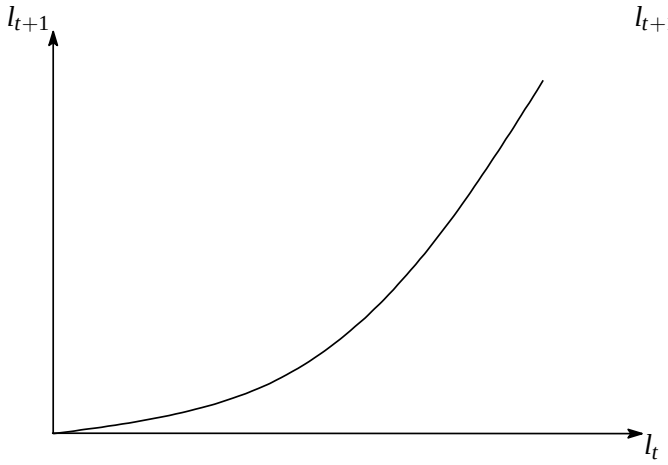

Figure 4 $\sigma \geq 0$

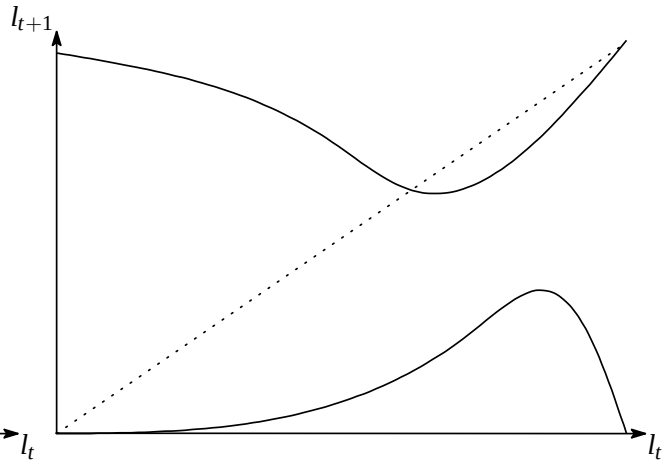

Figure 5 $\sigma \in (-1,0)$.

Defnition 2 ***(Politico-Economic Equilibrium)*** *A politico-economic equilibrium is a sequence* $\{\tilde{w}_t, l_t, c_t^y, c_t^o, \tilde{R}_{t+1}, g_t\}_{t=0}^{\infty}$ *that accords with the following.*

(i) Given the sequence $\{\tau_t, \theta_{ft}, \theta_{wt}\}_{t=1}^{\infty}$*, each agent (young or elderly) determines the policy variables that maximize their individual utility. That is, the optimal policy variables meet the following maximization problem:*

$$\max \ln(c_t^{yi}) + \frac{1}{1+\rho} \ln(c_{t+1}^{0i}), \quad i \in (e,u)$$

Based on the solutions of such problems, the tax policy by which both generations are alive in the same period as that in which demand is determined.

(ii) The budget constraints of pension and unemployment insurance are balanced in each period.

(iii) Finally, the following markets clear.
Commodity Market: Eq. (11)*, Capital Market: Eq.* (12)*, Labor Market: Eq.* (13)

3.2 The Dynamics of the Employment rate

Next, we have to investigate the dynamics of the employment rate. From the labor market equilibrium condition, eq.(13), we can derive the dynamics.

$$l_{t+1} = \phi(l_t) \tag{14}$$

Fig 4 and 5 depicts the dynamics of the employment rate. If the employment rate is less than the half of population, the unemployment constitute the majority of this economy. The case of divergence as in fig. 4 is out of our analysis. We focus on the case of fig. 5.

4 Voting: Regime Switching

We then consider the voting behavior regarding pension and unemployment insurance. We assume that

1. Voting is held in each period.
2. Voters consist of both young (the employed and unemployed) and old that are remain in each period.
3. The policy determination is based on majority voting.
4. The voting is repeated among successive generations of voters.

Following Conde-Ruiz and Galasso (2005), we adopt the concept of a structure-induced equilibrium which is developed by Shepsle (1979). We then investigate the preference to each policy variable. The indirect utility functions of the worker and the unemployed are respectively derived as

- the employed

$$V^e(\cdot) = \ln[(1-\tau_t-\theta_{ht})w_t l_t] + \frac{1}{1+\rho}\left[\ln\frac{1+\rho}{2+\rho}\left\{\frac{1}{1+\rho}(1-\tau_t-\theta_{ht})w_t - \frac{d^e_{t+1}}{R_t}\right\} + d^e_{t+1}\right] \quad (15)$$

- the unemployed

$$V^u(\cdot) = \ln[(1-\tau_t)w_t l_t] + \frac{1}{1+\rho}\left[\ln\frac{1+\rho}{2+\rho}\left\{\frac{1}{1+\rho}(1-\tau_t)u_t - \frac{d^u_{t+1}}{R_t}\right\} + d^u_{t+1}\right] \quad (16)$$

First, the preference to pension system of the employed and unemployed is as follows:

- the employed

$$\theta_t^{*,e} = \arg\max V^e(\cdot) \quad (17)$$

- the unemployed

$$\theta_t^{*,u} = \arg\max V^u(\cdot) \quad (18)$$

On the other hand, the preference to unemployment insurance of the employed is as follows:

- the employed

$$\tau_t^{*,e} = \arg\max V^e(\cdot) \quad (19)$$

We then derive the $\frac{\partial V^e}{\partial \tau}$, $\frac{\partial V^u}{\partial \tau}$, $\frac{\partial V^e}{\partial \theta_w}$, and $\frac{\partial V^u}{\partial \theta_w}$.

The optimal solution can be derived as an intersection of the following two reaction functions:

$$\theta_t = \theta(\tau) \quad (20a)$$
$$\tau_t = \tau(\theta) \quad (20b)$$

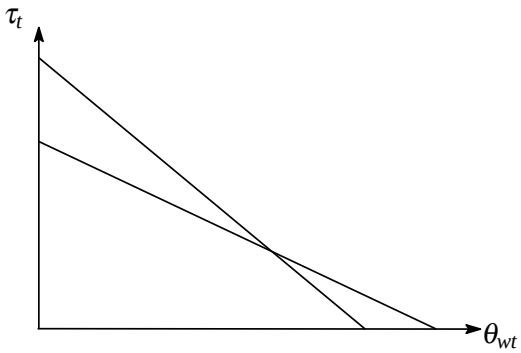

Figure 6　Case 1.

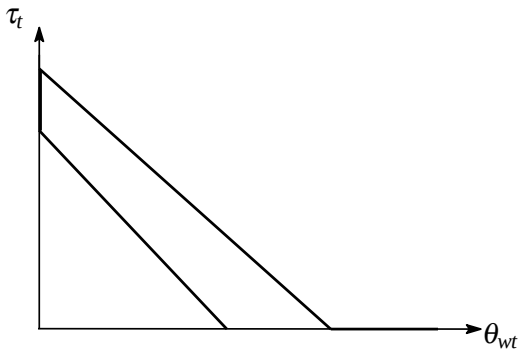

Figure 7　Case 2.

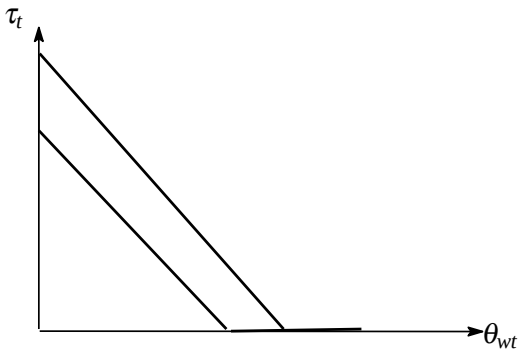

Figure 8　Case 3.

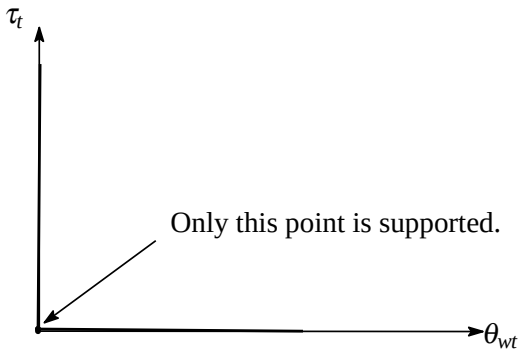

Figure 9　Case 4.

As in the case of fig.6, both the pension and the unemployment insurance are adopted, whereas, neither pension nor the unemployment insurance are supported, which means the social security system vanishes.

Case 1 is the corresponding to the situation in which both pension and unemployment insurance survives. Case 2 and 3 show the situation in which either pension system and unemployment insurance survives. Case 2 is the situation in which pension system does and case 3 is unemployment insurance. Finally, case 4 depicts the situation neither pension nor unemployment insurance survives.

To summarize, we then obtain the following proposition:

Proposition

Depending on the dynamics of capital accumulation and the unemployment rate, the contents of social security system varies in following four patterns.

Case 1. Both pension and unemployment insurance policies survive.

Case 2. Only pension policy survives

Case 3. Only unemployment insurance survives.

Case 4. None survives.

5 Conclusion

This paper shows how the social security system evolves as attribution of voters changes. In our setting, policy determination is based on majority voting and the government has two kinds of social security policy; pension and the unemployment insurance. That is, when the workers constitute the majority of voters, pension system is supported and when the unemployed is the majority, the unemployment insurance is adopted. Under such a situation, we show how the contents of the social security system evolves depending on the dynamics of capital accumulation and the unemployment rate, and show the social security system vanishes in certain instances. This result may explain the future of social security policy in the developed countries including Japan.

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