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Endogenous Business Cycle under Wage Markup Bargaining

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Abstract

This paper presents a simple model of wage markup bargaining by employees and employers. The purpose of this study is to examine the dynamics of wage and unemployment. Results show that the economy exhibits complicated endogenous business cycles according to productivity, the sensitivity of firm responses, and the size of potential work force. The model is successful for describing the complex dynamics of wages and employment using the simplest framework.
Keywords: Collective bargaining; Wage markup; Business Cycle
JEL classification: E32; J50

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1 Introduction

Negotiation between labour and management on labour contracts plays an important role in wage determination in most industrialised countries because labour relations in these industrialised countries are regulated by labour laws that institutionalise fundamental conditions such as employee representation, trade union formation, collective bargaining, and arbitration rulings of labour disputes.

In practise, the union density and bargaining coverage rates underscore the importance of collective agreements concluded by labour and management. Figure 1 presents trade union density and collective bargaining coverage in thirty OECD countries, including Brazil, India and South Africa.[1] The tendency of union coverage in countries with high union density is toward a higher percentage. Furthermore, countries with 50% or greater union coverage constitute about half of countries surveyed.

The pioneering study of collective bargaining was that of Dunlop (1944), presenting the theory of wage determination by a monopoly union. A monopoly union sets a wage after taking the labour demand of a firm into account. Therefore, the wage rate set by the monopoly union is higher than the competitive wage rate, and its higher wage rate brings about involuntary unemployment.

Conventional analyses of collective bargaining have explained it as a cooperative bargaining game since the pioneering study.[2] Especially, McDonald and Solow (1981) provide an efficient contracts model in which it is assumed that negotiations over wages and employment are conducted simultaneously, and the monopoly union model is generalised as a right-to-manage model by Nickell and Andrews (1983).

The wage bargaining models provided a basic framework to analyse various issues of investment, social security, fiscal policy and so on (e.g., Grout 1984; Van der Ploeg 1987; Devereux and Lockwood 1991; Corneo and Marquardt 2000; Kaas and Thadden 2004).[3] Especially, Kaas and Thadden (2004) present dynamic analyses of an economy with wage bargaining and the public sector. As in Kaas and Thadden (2004), the models of collective bargaining have been used to investigate equilibrium dynamics in the economy.

Regarding studies described in reports during the last decade, Imoto (2003)

[1] the OECD countries in Figure 1 are Australia*, Austria**, Belgium, Canada**, Czech Republic**, Denmark*, Estonia, Finland*, France, Germany**, Greece, Hungary**, Iceland, Ireland, Italy**, Japan, Korea, Luxembourg, Netherlands, New Zealand*, Norway, Poland, Portugal**, Slovakia, Slovenia, Spain*, Sweden, Switzerland, the United Kingdom** and the United States**. Data for countries without superscripts are those of 2008. Data for countries with "$*$" are those of 2007. Data for countries with "$**$" are those of 2009.

[2] Another approach is regarding it as a strategic game, as did Rubinstein (1982). Binmore et al. (1986) show that the solution of the bargaining game presented by Rubinstein (1982) converges to the generalized solution of Nash (1950, 1953) under some conditions.

[3] See Manzini (1998) for a review of the literature. Grout (1984), Van der Ploeg (1987), and Devereux and Lockwood (1991) examine the effects of trade unions on capital, and treat the hold-up problem. Hart and Moore (1988) show that underinvestment is a result of non-binding contracts in general settings. Corneo and Marquardt (2000) investigate the effect of social security on unemployment.

and Ono (2007) show the possibility of the existence of growth cycles in an overlapping generations model with wage bargaining. The source of the business cycle is a combination of capital accumulation, social security and the elasticity of substitution between the wage and the employment rate within union preferences.

Strong substitutability between the wage and the employment rate within union preferences engenders a negative correlation between the employment rate and the wage rate. The incorporation in the model of social security reflects total saving in the economy through income distribution between employed people and the unemployed people. The dynamic equation of capital accumulation displays a locally (or globally) downward slope that generates economic fluctuations.

Imoto (2003) and Ono (2007) shed some light on the effect of trade unions on the business cycle. Especially, they contribute to clarification of the importance of union preference. However, those earlier studies present the limitation of leaving bargaining on future working conditions out of consideration. It is necessary to develop another approach to analysing the bargaining that occurs between labour and management. That approach should include this viewpoint.

Therefore, we develop a simple model incorporating a wage markup rate as a bargaining target. Using it, we investigate wage and employment dynamics. It is reasonable for our analyses to presume that the target of this negotiation is associated with the markup rate of future wages. The negotiation related to a wage markup rate implies that a future wage rate is determined as a scalar multiple of the realized current wage rate, and that it enables analyses of wage and employment dynamics. At this point, we depart from the conventional model of wage bargaining.

Major concerns of this paper are first whether negotiation between labour and management over labour contract itself generates a complicated business cycle or not, and secondly, characterisation of the dynamics of wages and employment. A sufficient condition for generating economic fluctuations is provided to enable characterisation of the wage and employment rate dynamics.

The remainder of this paper is organised as follows. Next, section 2 presents a description of our model and a solution to it, then characterises the dynamics of the economy. Section 3 provides the dynamic sequences of wage and employment rate through numerical simulation. Finally, Section 4 concludes this paper.

2 The economy

The number of households is assumed to be N with no population growth. The labour endowment of each household is normalised to unity; households supply it inelastically. The households earn labour income, some obtaining a dividend from profits; the households expend current consumption. Their utility is defined over their total income.

The final goods are producible using labour input alone. The production function is formulated as

$$Y_t = f(L_t), \tag{1}$$

where Y_t is the aggregate output and L_t the labour input. We assume that the production function f has the properties $f(0) = 0$, $f(\infty) = \infty$, $f'(\cdot) > 0$, $f''(\cdot) < 0$ and the Inada conditions.

By profit maximisation for a given wage rate, the inverse labour demand function is given as $w_t = f'(L_t)$ where w_t is the real wage rate. Let $\omega := f'(N)$. Then, the realised scale of employment is

$$L_t = \begin{cases} L(w_t) \text{ if } w_t > \omega \\ N \text{ if } w_t \leq \omega \end{cases}, \tag{2}$$

where $L'(w_t) = 1/f''(L_t) < 0$.

The bargaining process occurring between labour and management is explained as follows. At the end of the current period, labour and management make (or renew) the labour agreement of the subsequent period. Taking the current wage rate and employment volume as given, labour gathers and negotiates with management for their wage markup rate. The standard of the wage markup is the current wage rate. By its nature, the trade union is assumed to seek a high markup rate.

However, management desires a low markup rate subject to a wage payment reserve compared with a reasonable wage rate, which is $w_t - \omega$. Intrinsically, management would like to decrease the markup rate because it is connected directly with increasing profit; the wage rate might be nearly equal to zero in an extreme case. Indeed, management often hold a dominant position in information of financial status. The term of the wage payment reserve represents the financial status.[4]

According to the principle based on wage payment reserve, the bargaining behaviour of the firm is explained as follows.[5] If $w_t > \omega$, then the firm has a loss in a reasonable profit; the firm has no wage payment to spare. Therefore, the firm will set the reservation markup rate to a negative one. In contrast, the firm has a wage payment to spare if $w_t < \omega$. The firm will set the reservation markup rate to a positive one.

Let $g_{t+1} := (w_{t+1} - w_t)/w_t$ be the markup rate. Then, the bargaining problem described above is formulated as

$$\max_{g_{t+1}} g_{t+1} \times [r_t - g_{t+1}],$$

[4]It can also be assumed to be the profit reserve of the firm, i.e. $\pi(w_t) - \pi(\omega)$ where $\pi(w) := f(w) - wL(w)$. Then, the properties of production function reflect the first-order condition.

[5]The monopsonistic power of the firm is also a good reason to justify this assumption. Actually, results of several studies support this behaviour (e.g., Boal and Ransom 1997; Manning 2003; Michaelides 2009). Boal and Ransom (1997) survey the literature related to oligopsony power in the labour market. Manning (2003) develops an inclusive analysis from both theoretical and empirical viewpoints. Michaelides (2009) specifically examines the effects of the mobility costs of workers in an oligopsonistic labour market.

where r_t is reservation markup rate such as

$$r_t := \alpha \cdot \left(\frac{\omega - w_t}{\omega} \right).$$

Therein, α represents the sensitivity of the firm (a positive constant).

The first-order condition for bargaining problem engenders the following.

$$w_{t+1} = \phi(w_t) := \left[1 + \frac{\alpha}{2} \cdot \left(\frac{\omega - w_t}{\omega} \right) \right] w_t. \tag{3}$$

Equation (3) is the so-called logistic equation.[6] The steady-state wage rate is defined as $w^* = \phi(w^*)$. Using $w_{t+1} = w_t = w^*$ and (3), we obtain $w^* = \omega$.[7]

3 Dynamics of wages, employment and aggregate income

In this section, we investigate wages, employment rates and aggregate income dynamics. Before starting numerical analyses, we provide the analytical result related to dynamics of employment rate and aggregate income. First, the global stability of (3) is summarised as the following proposition.

Proposition 1. *Presuming that $w_0 < \omega$ holds, we can infer the following. (i) The wage rate converges monotonically to the steady-state wage rate ω if $0 < \alpha \leq 2$. (ii) The wage rate converges with oscillation to the steady-state wage rate if $2 < \alpha < 4$. (iii) If $4 \leq \alpha \leq 6$, then the sequence of wage rate displays a periodic cycle around the steady-state wage rate, especially, the sequence of wage rate exhibits chaotic dynamics in the Li–Yorke sense for α close to 6.*

Proof. See Appendix. □

According to Proposition 1, α is important to determine the stability of the economic dynamics. A stronger reactivity of the firm engenders a wider range of wage markup rate fluctuation proposed by the firm with respect to the standard of markup rate. A strong negative feedback is caused in the dynamic equation of wage under a high current wage rate. Therefore, economic fluctuation occurs for large α because a negative feedback provides a downward sloping of ϕ.

Figure 2 portrays an orbit diagram of (3).[8] According to Figure 2, we can check the occurrence of chaos and periodic windows when α is $5 - -6$. Regarding the first purpose of this paper, we conclude that the bargaining behaviour

[6] the map ϕ is a unimodal map because

$$\frac{dw_{t+1}}{dw_t} = 1 + \frac{\alpha}{2} - \frac{\alpha w_t}{\omega} \gtreqless 0 \Leftrightarrow w_t \lesseqgtr \left(\frac{2+\alpha}{2\alpha} \right) \omega, \text{ and } \frac{d^2 w_{t+1}}{dw_t^2} = -\frac{\alpha}{\omega} < 0.$$

[7] Another steady-state wage rate is $w^* = 0$.

[8] We set $\omega = 1$ and $w_0 = 0.25$, and plot w after letting the sequence evolve 200 iterations within $3.75 \leq \alpha \leq 6$.

in the institutionalised labour market engenders the complicated business cycles according to circumstances.

By Proposition 1, equations (1) and (2), we establish the following proposition:

Proposition 2. *Presuming that α is in $(0, 6]$ and $w_0 < \omega$, then the sequence of the employment rate and aggregate income display a monotonical or an oscillatory convergence to its steady-state level if α is sufficiently small. In contrast, the sequence of employment rate and aggregate income show cyclical fluctuations or chaotic fluctuations if α is sufficiently large.*

The fluctuations of the employment rate and aggregate income result from fluctuation of the wage rate. To ascertain these results, we next investigate the dynamics of wage, employment and aggregate income using numerical simulations. Let $Y_t = 500L_t^{0.7}$ and $N = 1$. Then, the reasonable wage rate is $\omega = 350$. We investigate three cases under $w_0 = 100$: $\alpha = 0.5$, $\alpha = 4.25$ and $\alpha = 5.75$.

Figures 3a and 3b present the sequences of the wage rate and of both aggregate income and labour share in the case in which $\alpha = 0.5$, respectively. In this case, the wage rate increases monotonically and converges to its steady-state value. Then, labour share is growing while the profit share is shrinking; labour share and profit share finally go to 0.7 and 0.3 respectively. Because the wage rate during transitional process is less than the reasonable wage rate, the employment rate is equal to unity and is time-invariant.

Figures 4a, 4b and 4c respectively display the sequences of the wage rate, of both aggregate income and labour share, and of the employment rate in the case in which $\alpha = 4.25$. Except for some early steps, the markets regularly oscillate between prosperity and recession; good times alternate immediately with bad because the wage rate exceeds its reasonable level as adjusted by negative markup rate results from bargaining.

Finally, Figures 5a and 5b respectively present sequences of both the wage rate and aggregate income and of the employment rate in the case in which $\alpha = 5.75$. The wage rate shows a complicated dynamics. In addition, aggregate income and labour share are mutually connected and display chaotic oscillations. In this case, economic trends are unpredictable: sometimes good times continue, then good times immediately alternate with bad.

4 Concluding remarks

This paper presented a simple model with wage markup bargaining and examined the dynamics of wage, employment and aggregate income. A contribution of the paper is that the endogenous business cycle is well explained using this extremely simple model. The source of economic fluctuations is the bargaining process, which provides a nonlinear dynamic equation of the wage rate in the well-institutionalised labour market.

This paper implies that the institutionalised behaviour of economic agents brings about unexpected and unwelcome outcomes such as economic fluctuations. However, this does not necessarily suggest that the institutionalised labour market is undesirable for the economy because their institutions are based on various principles including economics and historical experiences.

Nevertheless, it answers for solutions of economic fluctuations in the institutionalised labour market within the economics, i.e., a volatility regulation of markup rate and its institutionalisation. It prevents extremely high wages or low wages in the subsequent period. The realized wage rate will be going in the targeting range. In any case, the labour market policy is important to solve these types of fluctuations but fiscal and monetary policy cannot solve the economic fluctuations directly because they cannot affect bargaining processes.

Finally, we would like to consider the direction of future research. The bargaining outcome and its actual situation vary a great deal depending on the bargaining power relationship between labour and management.[9] The dynamic analysis of a power struggle on our study is insightful to investigate the economic dynamics used by the evolutional game theory presented by Maynard Smith (1982). This topic will be important for future investigations.

[9] Falch and Strøm (2007) investigate the wage bargaining in an oligopsonistic labour market.

Appendix: Proof of Proposition 1

The critical point of ϕ is $(\hat{w}, \phi(\hat{w}))$ where $\hat{w} := \omega/\alpha + \omega/2$. The steady state is identical to the critical point if $\hat{w} = \omega$. Because the gradient of ϕ is zero at the critical point, the steady state where $\omega \leq \hat{w}$ is stable. Solving $\hat{w} = \omega$ with respect to α, we obtain $\alpha = 2$. $\hat{w}$ is decreasing in α. Therefore, the wage rate converges monotonically to ω if $0 < \alpha \leq 2$.

The gradient of ϕ is negative if $\alpha > 2$. If the gradient is less than unity, then the steady-state is oscillating stable. Solving $\phi'(w_t) = -1$ with respect to α, we obtain $\alpha = 4$. The gradient of ϕ is equal to -1 if $\alpha = 4$. Therefore, the wage rate oscillatorily converges to the steady-state wage rate if $2 < \alpha < 4$. Let $\alpha \geq 4$. Then, the gradient of ϕ is less than -1. Around the steady state, the wage rate will diverge from the steady state. However, the wage rate approaches the steady-state in the wage rate far from the steady state. The periodic cycle will result in $\alpha \geq 4$.

Finally, we consider a sufficient condition for chaotic dynamics. We define $\check{w}$ as the backward iteration of $\hat{w}$, i.e. $\check{w} := \phi^{-1}(\hat{w})$. $\check{w}$ is a positive by the property of ϕ. Regarding the maximum value of capital stock such as $\phi(\bar{w}) = 0$, we obtain $\bar{w} = 2\omega/\alpha + \omega$. We have $\bar{w} = \phi(\hat{w})$ if the iteration of $\hat{w}$ is equal to $\bar{w}$. Solving it with respect to α, we obtain $\alpha = 6$. Therefore, $0 < \check{w} < \hat{w} < \bar{w}$ holds. Applying the Li–Yorke theorem, the map ϕ is a chaotic map in the Li–Yorke sense.

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Figures

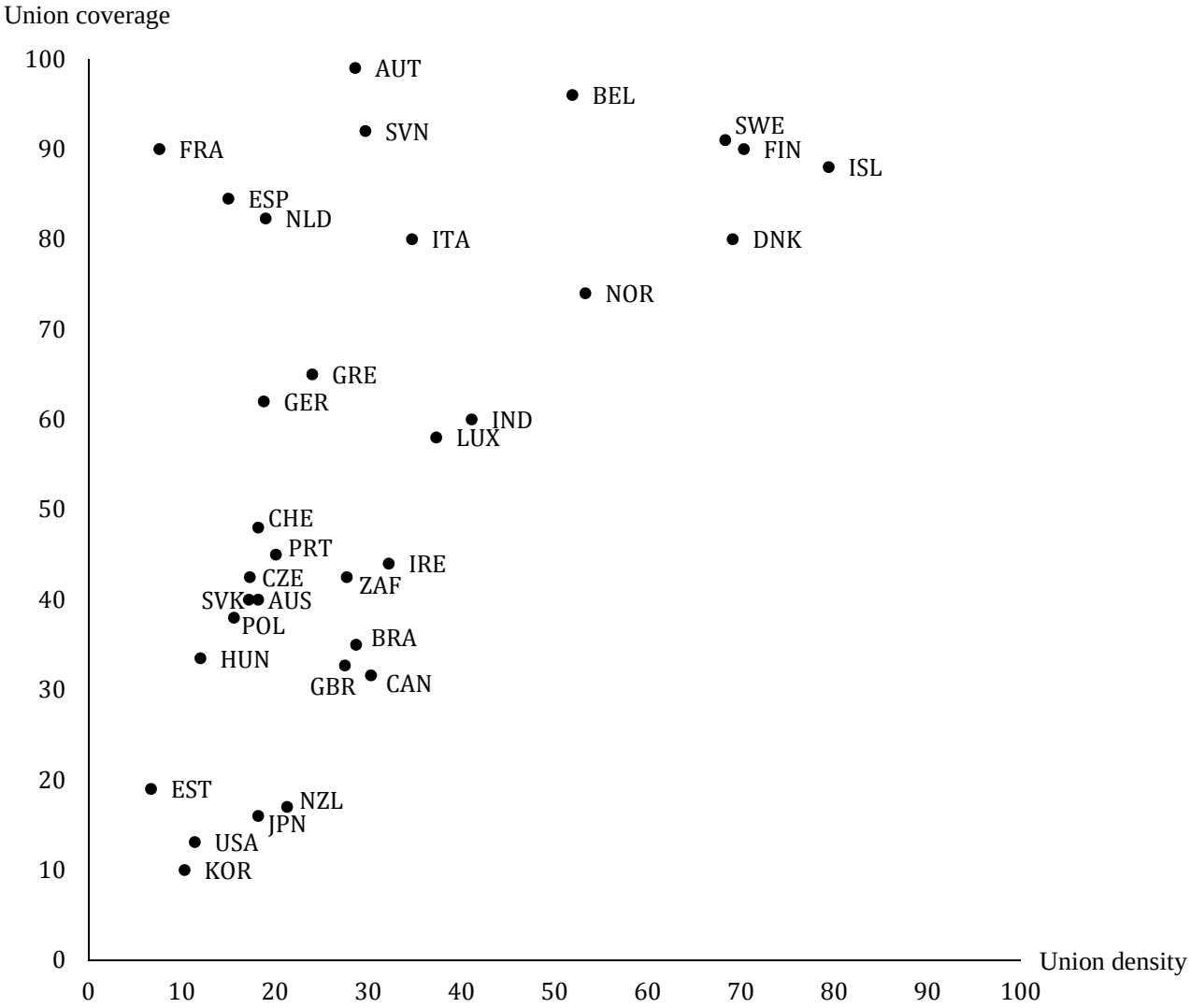

Figure 1. Union density and union coverage

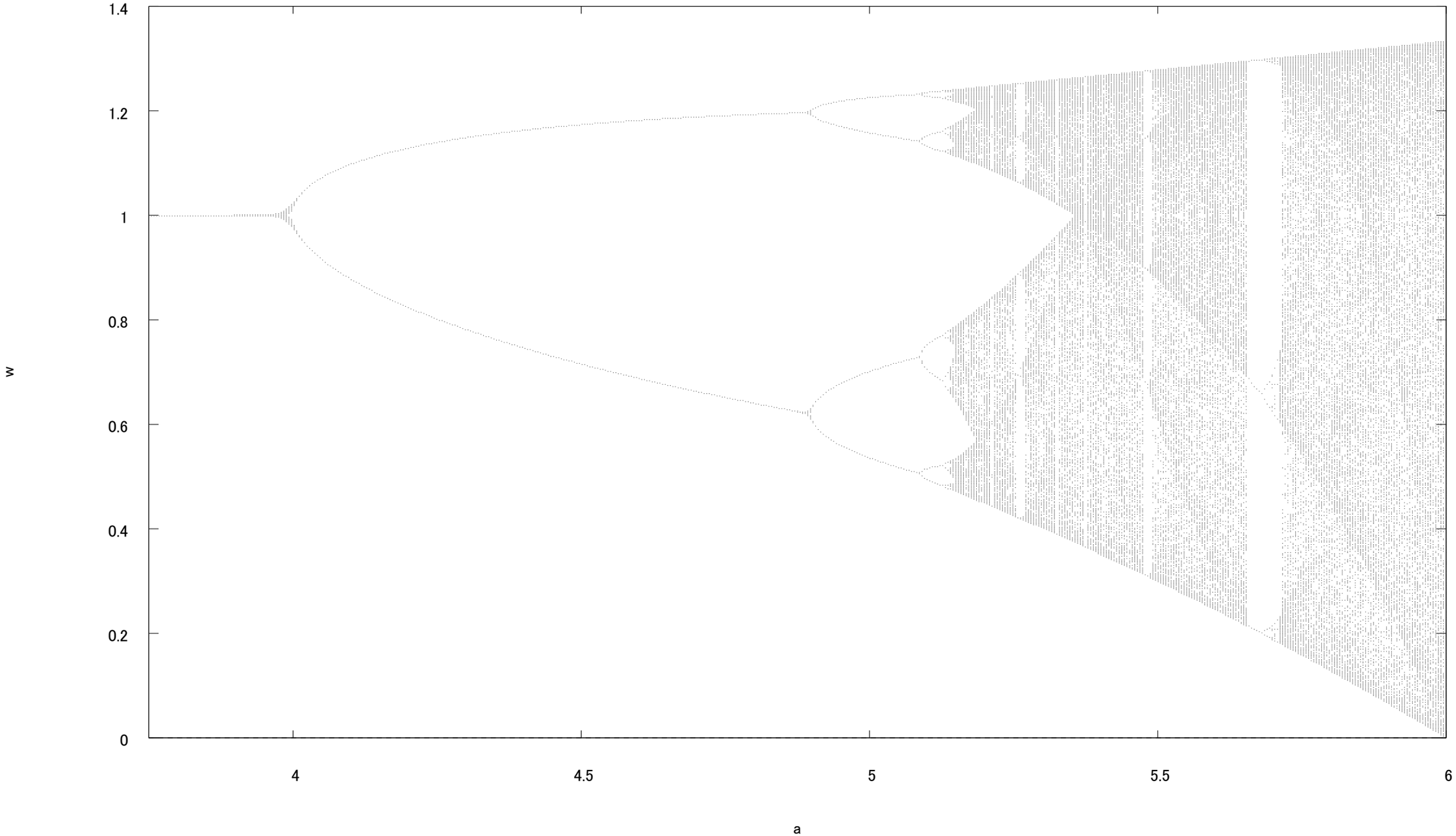

Figure 2. The orbit diagram

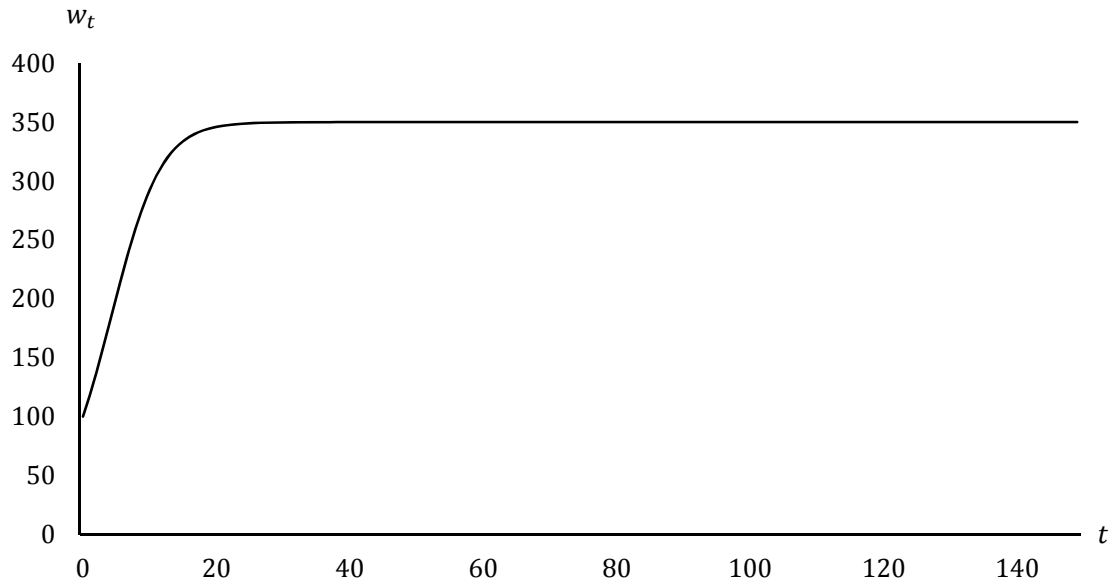

Figure 3a. The sequence of wage rate

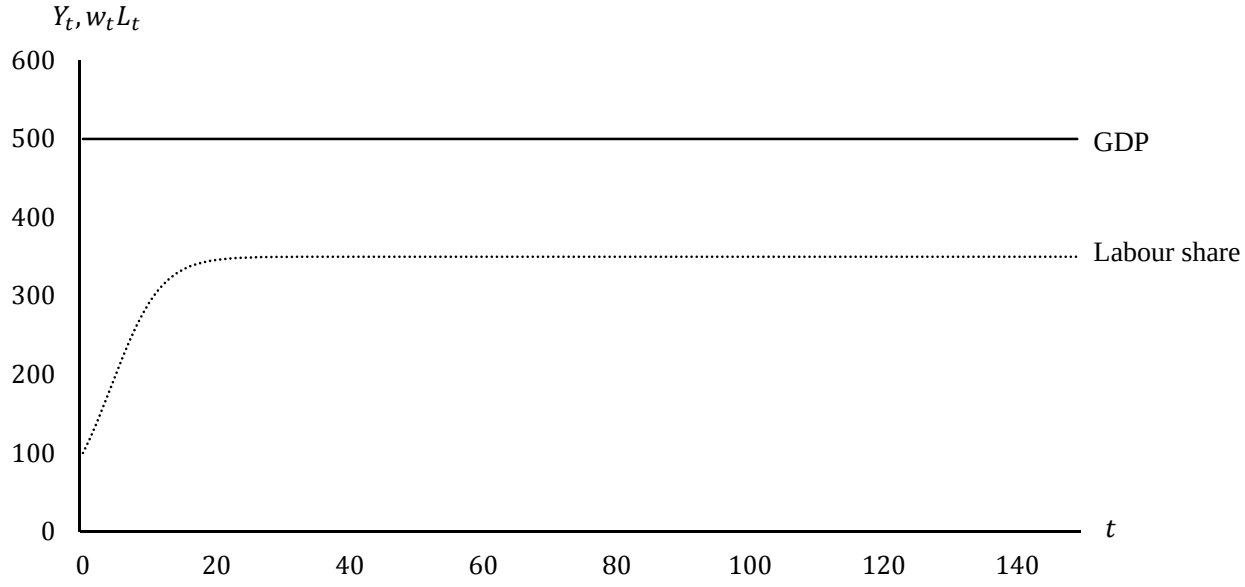

Figure 3b. The sequences of GDP and Labour share

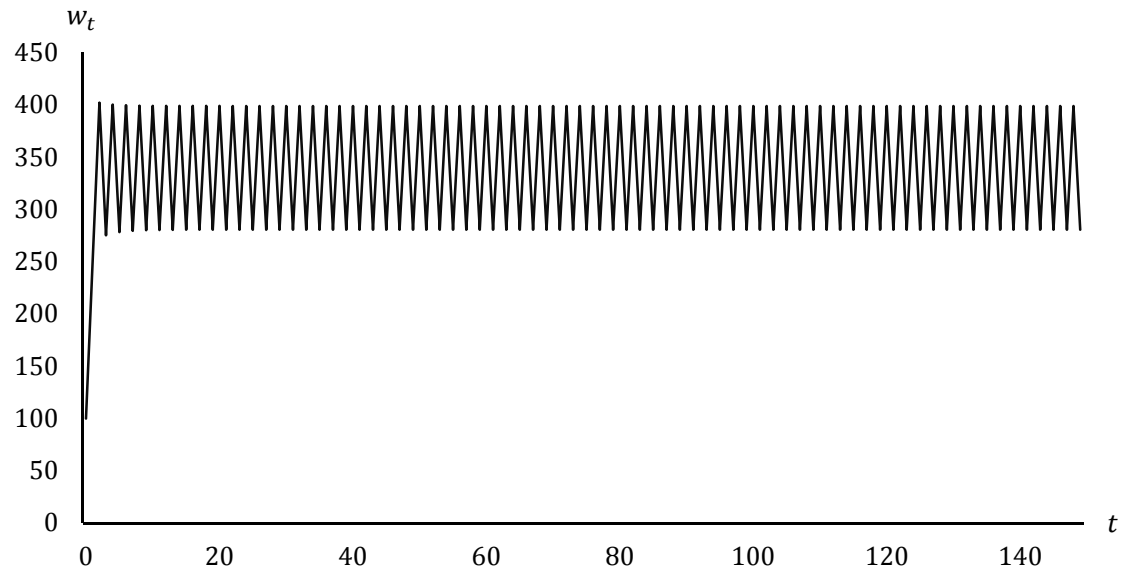

Figure 4a. The sequence of wage rate

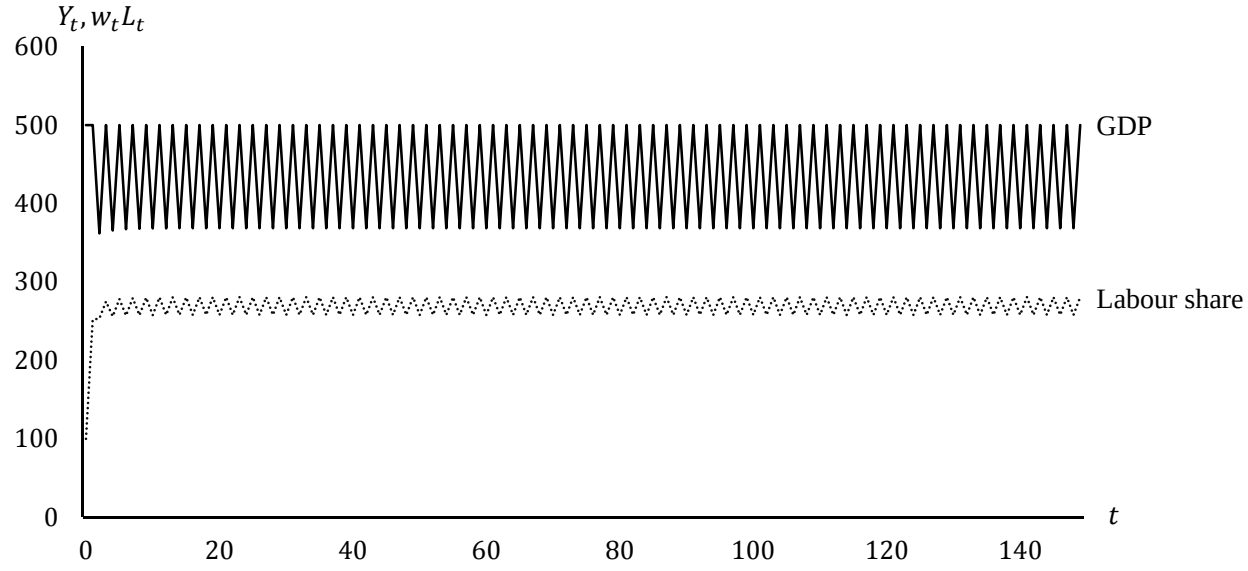

Figure 4b. The sequences of GDP and Labour share

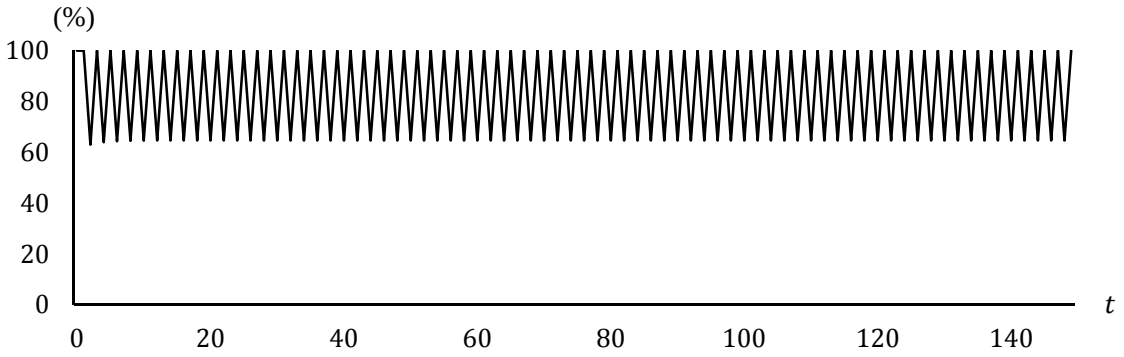

Figure 4c. The sequence of employment rate

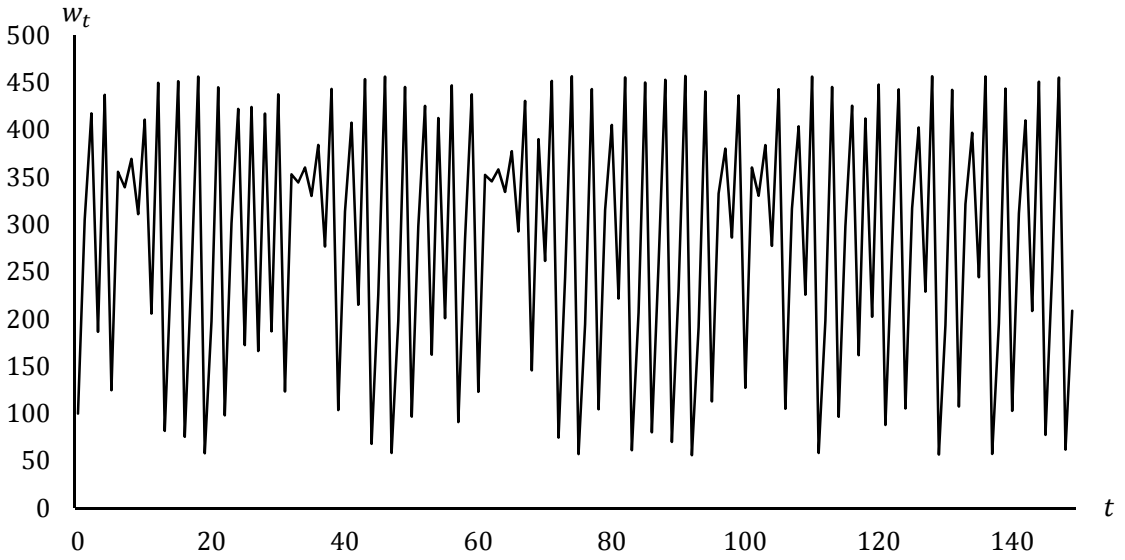

Figure 5a. The sequence of wage rate

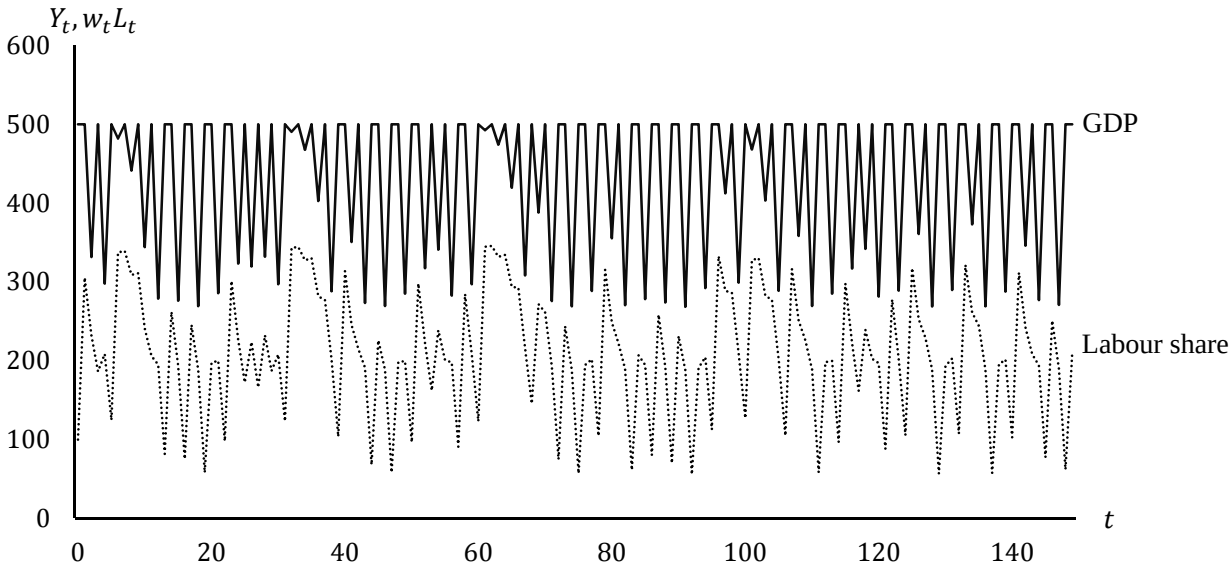

Figure 5b. The sequences of GDP and Labour share

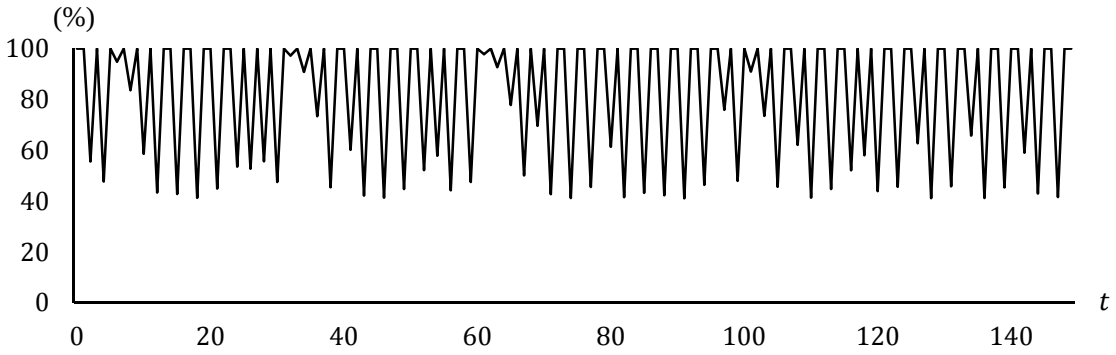

Figure 5c. The sequence of employment rate