研究ノート

Secession, Economies of Scale, and Fiscal Policy

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1. Introduction

Recently, discussions of secession-related difficulties have arisen worldwide. Why do secession movements occur? Secession is likely to bring diversification of preferences for public policy. Such diversity might include different cultures, languages and ethnic groups (Hosoe, 2018a, p.3). For example, one might examine independence-related issues associated with Scotland.

Scotland's people hope for some delegation of authority related to public policy from the United Kingdom to Scotland. Moreover, they seek stronger control over oil and gas extracted from North Sea fields. The central government of the United Kingdom can collect all tax revenues from the North Sea and can control such tax revenues under the current public finance system. Scotland would need to confront the salient difficulty of obtaining sufficient tax revenue stability after becoming independent from the United Kingdom. Regarding public finance related circumstances in Scotland, fiscal transfers from the central government have come to account for almost all of the financial resources of Scotland.

Viewed comprehensively, one must consider difficulties related to public policy and particularly fiscal policy if the government of the United Kingdom should choose to prevent secession. Other secession difficulties have persisted

throughout the world: Catalonian independence from Spain is often in the news.

Buchanan and Faith (1987) use a model of public goods provision to study income tax policy undertaken to prevent secession. Especially, they show that the number of actors in the sharing coalition affects the optimal income tax level to prevent secession by potential seceders. Although they analyze the income tax policy necessary to prevent secession, they do not consider a fiscal transfer policy or distributions of revenues from natural resources. Furthermore, they do not analyze public policy related decision-making.

Regarding decision-making related to public policy, in terms of political economics or political science, several reports describe political delegation among politicians and bureaucrats, as reported by Epstein and O'Halloran (1998). They use a bliss-point approach, where the utility of each resident depends on the distance between the most favorable policy and the actual policy. They analyze the optimal degree of delegation of policy decision to bureaucrats by politicians. It is interesting to apply this policy preference model to a regional secession problem. Hosoe (2016) uses the bliss point approach to analyze the mechanisms of integration and secession in regional models with policy preferences and policy conflict costs. Hosoe (2018b) and Sato (2018) study the mechanisms of integration and secession in a three-region model using a policy preference approach. They also consider the economies of scale in their model. However, they do not consider the distribution of profits from natural resources under secession.

Other research into issues related to secession has been conducted from the perspective of political economics. Alesina and Spolaore (1997) analyze the forces shaping incentives for secession, particularly addressing the traditional tradeoff between economics of scale and heterogeneity of preferences. Furthermore, Alesina and Spolaore (2003) and Haimanko (2005) study

compensation mechanisms among regions such that inefficient secession can be avoided using a voting model. The question is then whether interregional compensation mechanisms exist such that potentially seceding regions are strictly better off by remaining in the union. Gradstein (2004) examines the efficiency of public production under a local election model of the representative in each region considering integration bargaining with a secession term.

Although they analyze regional secession from the perspective of political economies, they specifically examine only the provision of public goods. They do not use a bliss-point approach, but instead analyze public policy and fiscal transfer policy under an integrated economy to prevent secession. Moreover, they do not consider the distribution of profits from natural resources under secession.

According to the background of research efforts such as this, Ohno (2018) analyzes public policy, regional transfer policy, and income tax policy toward an internal exit using a public good provision model and a bliss-point approach. Here, Ohno (2018) considers difficulties related to the distribution of revenues derived from the exploitation of natural resources under secession.

Although Ohno (2018) analyzes secession considering the distribution of revenues from exploitation of natural resources, economies of scale are not addressed. When discussing secession problems, the population in the region is an important factor when considering fiscal policy. The population increase in the region affects regional economies of scale. Consequently, it is necessary to consider the economies of scale to examine effects of the optimal transfer policy along with a population increase in the region.

According to the background of research efforts such as this, we use the public goods provision model and the bliss point approach to analyze regional transfer policy and income tax policy toward an internal exit. After considering the distribution of profits from exploitation of natural resources

after secession, we also consider population-related economies of scale.

These analyses indicate the following main conclusions. First, the optimal income tax rate under an integrated economy is higher than the optimal income tax rate under a secession economy. Secondly, when economies of scale under an integrated economy are large (small), the optimal transfer decreases (increases) with the population in a minority region. This result differs from that presented by Ohno (2018), who demonstrates that optimal transfer increases with population in a minority region.

2. Model

Two regions, B and A, have respective populations of n_B and n_A, satisfying $n_A > n_B$, with income $I(>0)$. Here, we assume that n_A is normalized to 1. Therefore, region B is the minority region. Region A is the majority region. Region A implements an income redistribution policy. Region A taxes the income in region A and region B under an integrated economy. The income tax rates in region A and region B are t under the integrated economy. Consequently, the tax revenue in region A under the integrated economy is the following.

$$T = tI + tIn_B \tag{1}$$

We specifically examine the benefits from natural resources. We assume that region A can perfectly control natural resources in region B under an integrated economy. We also assume that region B can perfectly control natural resources in its region under a secession economy. Region B cannot benefit from natural resources under a secession economy because skilled laborers

who can technically control natural resources do not reside in region B.

Region A can control a natural resource (e. g., oil.) in region B under an integrated economy. Region B is therefore subordinate to region A. The total tax revenue from a natural resource is R. Here we assume that R is sufficiently large. The total transfer from region A to region B is denoted by G. Considering the discussion presented above, we can denote the utility U_A, U_B of representative residents of the respective regions as shown below when region A implements a policy X_A:

$$U_A^N = -a(\overline{X}_A - X_A)^2 + I - tI + \gamma(T + R - G) - ct^2 + K(1 + n_B) \tag{2}$$

$$U_B^N = -b(\overline{X}_B - X_A)^2 + I - tI + \gamma G + K(1 + n_B) \tag{3}$$

In eq. (2), the first term represents the benefit from the public policy. Parameter a stands for the marginal benefit from the public policy in region A. It is assumed that $0 < a < 1$. The second term and the third term denote the benefits from the consumption of a numeraire good using disposable income. The fourth term represents the benefits from public good consumption. The marginal benefit of consumption of a public good is γ. Here, we assume that $\frac{1}{n_B} < \gamma < \frac{2(c+I)}{I(1+n_B)}$. The fifth term represents the collection under an integrated economy. Parameter c stands for the marginal collection cost. It is assumed that $0 < c < 1$. The sixth term represents economies of scale under an integrated economy[1]. $K(1 + n_B)$ denotes the benefit from economies of scale under an integrated economy. Here, $K(>0)$ represents marginal productivity with respect to the scale for region A and region B. Explanations of the respective terms in eq. (3) are the same as those of eq. (2). Parameter b expresses the marginal benefit from public policy in region B. We assume that $0 < b < 1$. Regarding the fourth term in eq. (3), region B provides a public

good in its region using a transfer from region A. Region B residents receive benefits from the consumption of the region's public good.

3. Secession case

Under a secession economy, region B can obtain perfect authority over its natural resources. Consequently, region A cannot receive benefits from natural resources because region A has no authority over the use of its natural resources. Region B can choose a common public policy and income tax in its region. However, region B cannot receive a transfer from region A. Region B must provide public expenditures from its region's tax revenue. Under such circumstances, region A's utility function under a secession economy is the following.

$$U_A^S = -a(\overline{X}_A - X_A)^2 + I - t_A I + \gamma t_A I - ct_A^2 + K_A \tag{4}$$

In eq. (4), the first term represents the benefit from the public policy. When the actual public policy decision is far from the bliss point, the utility of a representative citizen is low. Here, parameter $a(>0)$ represents the degree of damage. The second term and the third term are the benefits from the consumption of a numeraire good using disposable income. The fourth term represents the benefits from public good consumption. The fifth term represents the collection under a secession economy. The sixth term represents economies of scale under a secession economy.

K_A is the benefit from economies of scale. Here, K_A (>0) is marginal productivity with respect to the scale for region A.

However, region B's utility function under secession is the following.

$$U_B^S = -b(\overline{X}_B - X_B)^2 - s(X_B - X_A)^2 + I - t_B I + \gamma(t_B n_B I + \alpha R) - ct_B^2 + K_B n_B \quad (5)$$

In region B's utility function, the degree of benefits that region B can receive from natural resources is $\alpha\,(0 < \alpha < 1)$. Parameter α is an exogenous variable, signifies that region B cannot receive benefits from natural resources under a secession economy because skilled laborers who can control natural resources technically do not exist in region B. These skilled laborers reside in region A. We can also infer that region B cannot receive benefits from natural resources perfectly because educational costs apply to unskilled laborers in region B.

In region B's utility function, the degree of policy externality is denoted by $s\,(0 < s < 1)$. The second term shows the policy externality from the independence of region B from region A.

In eq. (5), the first term represents the benefit from public policy. When the actual public policy decision is far from the bliss point, the utility of a representative citizen decreases. Here, parameter $b\,(>0)$ is the degree of the damage. The second term shows the policy externality. The third term and the fourth term are benefits from the consumption of a numeraire good using disposable income. The fifth term represents the benefits from public good consumption. The sixth term represents the collection under a secession economy. The seventh term represents economies of scale under a secession economy. $K_B n_B$ is the benefit from economies of scale. Here, $K_B\,(>0)$ denotes marginal productivity with respect to the scale for region B. It is assumed that $K_B < K_A < K$.

The time line is the following. In the first stage, region A chooses the level of public policy K_A under an integrated economy. In the second stage, region A chooses the level of income tax rate t in region B and in its region. In the third stage, region A chooses the level of transfer G. In the fourth

stage, region B chooses whether to secede from region A, or not. Here, if region B chooses independence, then region B chooses a level of public policy X_B and a level of income tax rate t_B in its region[2]. Furthermore, region A chooses a level of public policy X_A and a level of income tax rate t_A in its region.

4. Analyses

We solve this game using backward induction. First, we analyze the secession case. We consider the case in which region B has chosen independence from region A. Region A chooses public policy and the income tax rate in its region to maximize region A's welfare under a secession economy (eq. (4)). The optimal level of public policy for region A is

$$X_A = \overline{X}_A \quad . \tag{6}$$

In addition, the optimal level of income tax rate in region A under a secession economy is the following.

$$t_A^* = \frac{(\gamma - 1)I}{2c} \tag{7}$$

From the assumption of γ $\left(\frac{1}{n_B} < \gamma < \frac{2(c+I)}{I(1+n_B)}\right)$, $0 < t_A^* < 1$ holds.

Accordingly, region A's welfare at the optimal level of public policy and income tax rate under a secession economy is the following.

$$U_A^{S^*} = I - t_A^* I + \gamma\, t_A^* I - c t_A^{*2} + K_A \tag{8}$$

By contrast, region B chooses the public policy and income tax rate in its region to maximize region B's welfare under secession (eq. (5)). Consequently, the optimal level of public policy for region B is the following.

$$X_B = \frac{b\overline{X}_B + s\overline{X}_A}{b+s} \tag{9}$$

The optimal income tax rate in region B under a secession economy is the following.

$$t_B^* = \frac{(\gamma n_B - 1)I}{2c} \tag{10}$$

From the assumption of $\gamma\left(\frac{1}{n_B} < \gamma < \frac{2(c+I)}{I(1+n_B)}\right)$, $0 < t_B^* < 1$ holds.

Accordingly, region B's welfare at the optimal level of public policy and the income tax rate under a secession economy are calculated as shown below.

$$U_B^{S*} = \frac{bs(\overline{X}_B - \overline{X}_A)^2}{b+s} + I - t_B^* I + \gamma(t_B^* n_B I + \alpha R) - ct_B^{*2} + K_B n_B \tag{11}$$

Here, if the region chooses independence, then utility eq. (11) is realized.

Next, we analyze region B's secession-related decision-making. From eq. (3) and eq. (11), if the following condition is satisfied, then region B will not be independent from region A.

$$U_B^{S*} \leqq U_B^N \tag{12}$$

From eq. (12), when a public policy X_A and an income tax rate t under an integrated economy are given, the optimal level of transfer G for region A

to prevent secession is the following.

$$G^{'}=\frac{1}{\gamma}\{b(\overline{X}_B-X_A)^2-\frac{bs(\overline{X}_B-\overline{X}_A)^2}{b+s}+(t-t_B^*)I-ct_B^{*2}-K(1+n_B)+K_Bn_B\}+t_B^*n_BI+\alpha R \tag{13}$$

Therefore, we can obtain the following lemma.

Lemma 1

When income tax rate t is given, optimal decision making with regard to transfer policy under an integrated economy to prevent region B's independence is that shown in eq. (13).

We substitute eq. (13) for eq. (2): one can derive region A's utility function as presented below.

$$U_A^N=-a(\overline{X}_A-X_A)^2+I-tI+\gamma(T+R-G^{'})-ct^2+K(1+n_B) \tag{14}$$

Region A decides the level of income tax rate in its region and region B to maximize utility eq. (14). One can derive the optimal level of income tax rate under an integrated economy as presented below.

$$t^*=\frac{(\gamma+\gamma n_B-2)I}{2c} \tag{15}$$

From the assumption of $\gamma(\frac{1}{n_B}<\gamma<\frac{2(c+I)}{I(1+n_B)})$, $0<t^*<1$ holds.

Next, we compare the optimal level of income tax rate under an integrated

economy and the optimal level of income tax rate in region B under a secession economy. Comparison of the optimal tax rates can be done according to the equation below.

$$t_B^* - t^* = \frac{I}{2c}(-\gamma + 1) < 0 \tag{16}$$

Accordingly, we can obtain the following proposition.

Proposition 1

The optimal income tax rate under an integrated economy is higher than the optimal income tax rate in the minority region under a secession economy.

The interpretation of this proposition is the following. Region A can collect income tax from region A and region B under an integrated economy. However, under a secession economy, region B can collect income tax revenues from its region. Accordingly, the marginal benefit of the income tax rate in an integrated economy is greater than the marginal benefit of income tax rate in a secession economy. Because this effect is large, the optimal income tax rate under an integrated economy is higher than the optimal income tax rate in region B under a secession economy.

We substitute Eq. (15) for Eq. (14). One can derive region A's utility function as presented below.

$$U_A^N = -a(\overline{X}_A - X_A)^2 + I - t^*I + \gamma(t^*I + t^*I n_B + R - G') - ct^{*2} + K(1 + n_B) \tag{17}$$

Region A decides the level of public policy X_A to maximize utility in Eq. (17). One can derive the optimal level of public policy X_A for region A as

$$X_A^* = \frac{a\overline{X}_A + b\overline{X}_B}{a+b}. \tag{18}$$

5. Optimal Transfer Policy

Next, we consider the optimal transfer policy to prevent region B's independence from region A. After substituting eq. (15) and eq. (18) for eq. (13), one can derive the optimal transfer policy to prevent region B's independence as shown below.

$$G^* = \frac{1}{\gamma}\{ b\,(\overline{X}_B - X_A^*)^2 - \frac{bs(\overline{X}_B - \overline{X}_A)^2}{b+s} + (t^* - t_B^*)\,I - ct_B^{*2} - K(1+n_B) + K_B n_B\} + t_B^* n_B I + aR \tag{19}$$

Here, we assume that the sign of eq. (19) is positive because of higher tax revenues from a natural resource R. Therefore, we can obtain the following proposition.

Proposition 2

Optimal decision making with regard to transfer policy under an integrated economy to prevent region B's independence is presented in eq. (19).

Next, we use comparative static analysis of the optimal transfer policy of eq. (19) related to parameter n_B. Thereby, we can derive the following equation.

$$\frac{dG^*}{dn_B} = t_B^* I + In_B \frac{dt_B^*}{dn_B} - \frac{2ct_B^*}{\gamma}\frac{dt_B^*}{dn_B} - \frac{K}{\gamma} + \frac{K_B}{\gamma} \tag{20}$$

The interpretation of eq. (20) is the following. In eq. (20), the first term and the second term represent the marginal benefit of increasing the tax revenue in region B under secession, based on the increase of region B's population. Consequently, as region B's incentive for secession increases, it is necessary for region A to increase the level of transfer to deter secession.

The third term shows an increase of marginal collection costs in region B under secession. That increase is based on the region B's population increase. If the region B's population increases, then the optimal income tax rate in region B increases under the secession economy. It follows that if the region B's population increases, then the marginal collection costs increase. Accordingly, to the degree that region B's incentive for secession decreases, region A can decrease its amount of transfer.

The fourth term represents an increase of economies of scale in region B under an integrated economy, based on increase of the region B's population. If the region B's population increases, then economies of scale in region B increase under the integrated economy. Consequently, if the region B's population increases, then the benefits of economies of scale increase. Accordingly, to the degree that region B's incentive for secession decreases, region A can decrease its amount of transfer.

The fifth term represents an increase of economies of scale in region B under a secession economy.

Especially, we can derive the following equation from Eq. (20).

$$\frac{dG^*}{dn_B} = \frac{n_B \gamma I^2}{2c} - \frac{K}{\gamma} + \frac{K_B}{\gamma} \tag{21}$$

From Eq. (21), we can obtain the following results.

$$\text{If } \frac{n_B \gamma^2 I^2}{2c} + K_B \geq K \quad \text{then } \frac{dG^*}{dn_B} \geq 0$$

$$\text{If } \frac{n_B \gamma^2 I^2}{2c} + K_B < K \quad \text{then } \frac{dG^*}{dn_B} < 0$$

From the relations associated with the above conditions of economies of scale and the sign of $\frac{dG^*}{dn_B}$, the following proposition can be obtained.

Proposition 3

When economies of scale under an integrated economy are large (small), the optimal level of transfer decreases (increases) with the population in region *B*.

The interpretation of proposition 3 is the following. When economies of scale under an integrated economy are small, the next two main effects exist. First, the effect of the marginal benefit of increasing the tax revenue in region *B* under secession exists. Next, the effect of an increase of economies of scale in region *B* under a secession economy exists. Because these two effects are large, the optimal level of transfer will increase with the population in region *B*.

6. Concluding Remarks

We use the public goods provision model and the bliss point approach to analyze regional transfer policy and income tax policy toward an internal exit. We also consider the distribution of profits from exploitation of natural resources under secession and the economies of scale with regard to

populations.

These analyses indicate the following main conclusions. First, the optimal income tax rate under an integrated economy is higher than the optimal income tax rate under a secession economy. Secondly, when economies of scale under an integrated economy are large (small), the optimal transfer decreases (increases) with the population in a minority region.

Future studies should assess the possibility of secession economies in terms of economies of scale and the distribution of profits from natural resources. As described herein, we assumed an exogenous degree of authority over natural resources. Therefore, future studies should be undertaken to analyze the decision of negotiation related to the degree of authority over the disposition of natural resources.

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（1）The model of economies of scale is similar to Hosoe (2018b).

（2）Spolaore (2008) analyzes how decentralization affects the incentives of the minority region to secede. In this study, when the minority region chooses independence from a majority region, a probability of failure of secession exists.