Volume LVI Nos. 1 and 2

ISSN 1655-1516
June and December 2019

The Philippine Review of Economics

FESTSCHRIFT FOR RAUL V. FABELLA

Guest Co-editors — **Emmanuel S. de Dios**, **Sarah Lynne S. Daway-Ducanes**

ARTICLES IN THIS ISSUE

A joint publication of the
University of the Philippines
School of Economics
and the **Philippine Economic Society**

The Philippine Review of Economics

A joint publication of the UP School of Economics (UPSE)
and the Philippine Economic Society (PES)

Aims and Scope: The *Philippine Review of Economics* (PRE) invites theoretical and empirical articles on economics and economic development. Papers on the Philippines, Asian and other developing economies are especially welcome. Book reviews will also be considered.

The PRE is published jointly by the UP School of Economics and the Philippine Economic Society. Its contents are indexed in the *Journal of Economic Literature*, EconLit, and RePec. PRE's readership includes economists and other social scientists in academe, business, government, and development research institutions.

Publication Information: The PRE (ISSN 1655-1516) is a peer-reviewed journal published every June and December of each year. A searchable database of published articles and their abstracts is available at the PRE website (http://pre.econ.upd.edu.ph).

Subscription Information:
Subscription correspondence may be sent to the following addresses:

- css@pssc.org.ph
- PSSC Central Subscription Service,
  PSSCenter, Commonwealth Avenue, 1101, Diliman, Quezon City, Philippines.
  P.O. Box 205, UP Post Office, Diliman, Quezon City, Philippines 1101
  PHONE: 922-9627, FAX: 924-4178/926-5179

Submissions: Authors may submit their manuscripts to the addresses below:

- pre@econ.upd.edu.ph or pre.upse@upd.edu.ph
- The Editor, The Philippine Review of Economics, Rm 237, School of Economics, University of the Philippines, Diliman, Quezon City, 1101.

Manuscripts must be written in English and in MS Word format. All graphs and tables must be in Excel format. Submission of a manuscript shall be understood by the PRE as indicating that the manuscript is not under consideration for publication in other journals. All submissions must include the title of the paper, author information, an abstract of no more than 150 words, and a list of 3–4 keywords. Complete guidelines can be viewed in the PRE's website.

Acknowledgements: The PRE gratefully acknowledges the financial support towards its publication provided by the Philippine Center for Economic Development (PCED). The Review nonetheless follows an independent editorial policy. The articles published reflect solely the editorial judgement of the editors and the views of their respective authors.

The Philippine Review of Economics

Vol. LVI Nos. 1 and 2 ISSN 1655-1516
June and December 2019 DOI: 10.37907/ERP9102JD

Festschrift for Raul V. Fabella

This special edition of the *Philippine Review of Economics* honors Dr. Raul V. Fabella in his 70th year and recognizes his invaluable contribution to the economics discipline and profession. This edition comprises 13 articles from his colleagues and several generations of former students inspired or mentored by Dr. Fabella who are themselves making their mark in economics. The broad spectrum of topics covered—agricultural economics, competition policy, contract theory, game theory, history of economic thought, international economics, issues in productivity, growth and development, monetary policy, political economy and rent-seeking, public economics, and the theory of teams—are issues that Dr. Fabella himself has written on or taught his students during his long, productive years as a Professor of Economics at the UP School of Economics, nurturing an "oasis of excellence" in his spheres of influence, as well as advocated as a roving academic in his later years, endeavoring to engage policymakers and the public in general, in pursuit of welfare-improving changes for a better Philippines.

The wide gamut of topics in this issue is a testament to Dr. Fabella's eclectic intellectual interests yet unwavering devotion to upholding a high standard of academic excellence. As his biographical sketch at the National Academy of Science and Technology summarizes:

> Fabella's very development as a scholar and intellectual leader presents numerous paradoxes: a classicist turned mathematical economist; a rational-choice theorist who derives material and metaphor from both history and physics; a solitary thinker who agonizes over pedagogy; a pure theorist immersed in policy-debate; an inherently shy, private man who must deal with crowds. His career displays to the fullest the range of issues – from the mathematical to the moral – that economists can and must confront if they are to attain to that "cool head and warm heart" that was Marshall's ideal. A classicist, however, might simply recall Terentius: *Homo sum: humani nil a me alienum puto*.

Indeed, to Dr. Fabella, nothing related to human behavior is outside his interest. At 70 years of age, National Scientist of the National Academy of Science and Technology (Philippines) and Professor Emeritus at the University of the Philippines, he is yet to reach the zenith of his intellectual verve: Fabella the economist is transfiguring into Fabella the social scientist – one to whom *homo economicus* is no longer the norm, but the exception in the vast complexity of human interactions in society. It is thus unlikely that this will be the last festschrift in his honor.

Sarah Lynne S. Daway-Ducanes
Emmanuel S. de Dios

PRE The Philippine Review of Economics 2019
56(1&2):236-256. DOI: 10.37907/12ERP9102JD

Public debt and the threat of secession

Rhea M. Molato-Gayares*
Asian Development Bank

This paper establishes a model of public debt as a strategic instrument in preventing secession. Using a dynamic game with perfect information, it shows that debt can be used to pre-empt a country's separation if the seceding region's potential gain from independence is strictly decreasing in debt. If so, the national government can prevent this region from leaving the union by setting higher levels of debt so that it reaches a certain threshold level. When the debt level is sufficiently high, this region will find it more beneficial to stay with the union rather than to become an independent state. This paper also finds that the majority region may use debt as a strategic instrument to preserve the union if it is better off in a country with debt than as a separate state with savings.

JEL classification: H77, H63, H30
Keywords: secession, debt, fiscal policy, sovereign debt

1. Introduction

Some countries have been dealing with threats of secession over long periods of time. As these secessionist conflicts remain unresolved, these same countries also carry high levels of public debt, as evidenced by public sector debt statistics from the World Bank and International Monetary Fund. What explains this persistence of unresolved secessionist conflicts alongside large national debt? Could these debt levels possibly explain why actual separation does not occur? This paper applies a game-theoretic framework to examine whether public debt plays a strategic role in preventing the breakup of nations.

The idea that public debt has the potential to prevent secession is contrary to the notion that higher levels of debt—and thus lower economic prosperity—is associated with political instability. True, many of the countries which encounter a threat of secession are characterized with less than stellar economic performance [Radan 2007]. There is no doubt that instability in the political environment affects economic outcomes adversely [Alesina and Perotti 1995] and it may well

* Please address all correspondence to rmolato@adb.org.

be argued that a bad economic situation can cause political unrest. As one form of political instability, a threat of secession may be driven and fuelled by a country's economic situation. Public debt brings adverse consequences to a country's future economic position. As such, it might be seen as a catalyst rather than a barrier to separation. This paper establishes an argument steering in the reverse direction. It delves into the micro foundations behind the possibility of secession and identifies a strategic mechanism through which debt works in the direction of preventing separation rather than facilitating it.

The outcome of Scotland's 2014 referendum on secession is a case in point. Surrounded by a debate concerning how the debt burden will be split in case of independence, the voters decided to remain in the United Kingdom. Similarly, for Quebec, citizens must face their share of the federal debt if they secede. After several rounds of referenda, Quebec remains part of Canada. Public debt is also a huge price to pay for Catalonia if it separates from Spain. These three cases illustrate that debt may have a role in pre-empting the breakup of nations.

The strategic mechanism identified in this paper works through the effect of debt on the seceding region's potential gain from independence. If the gain from independence is decreasing in debt, then by issuing higher levels of public debt, the national government in effect sets up stronger constraints on the economic environment that the seceding region will inherit in case it eventually becomes independent. Once debt reaches a sufficient threshold level, the seceding region may find it more beneficial to stay united in the country than to separate from it. Essentially, this paper shows that the threat of secession creates a tendency for a country to issue debt in an attempt to stabilize itself.

In this theoretical model, I consider a country where two regions differ in terms of preference for two public goods. Under a democratic setup, the majority region in this country is decisive over the level and composition of public spending. The minority region issues a threat of secession in order to obtain independence in making policy choices for its own jurisdiction. I consider the subgame-perfect equilibrium and identify conditions under which public debt can be used to preserve the union at the equilibrium outcome.

The central finding in this paper is that public debt can be a strategic instrument in preventing separation if the seceding region's potential gain from independence is decreasing in debt. If this condition is satisfied, the majority region may consider issuing higher levels of debt for the strategic purpose of preventing separation.

The rest of the paper is organized as follows. Section 2 relates this model with the existing literature on debt and secession. Section 3 describes the model and its assumptions. Section 4 considers a benchmark case where the threat of secession is absent. Section 5 analyses the minority region's decision when there exists a possibility of secession. Section 6 describes the majority region's optimal choice. Section 7 characterizes the equilibrium. The paper ends with a conclusion in Section 8.

2. Literature review

The secession decision is usually characterized as a trade-off between economies of scale and diversity in preferences (Casella [1992]; Alesina, Perotti and Spolaore [1995]; Alesina and Spolaore [1997]; Alesina, Spolaore and Wacziarg [2000]; Casella and Feinstein [2002]; Alesina and Spolaore [2005]; Ruta [2005]). This paper focuses on the difference in preferences as the motivation behind the possibility of secession and incorporates the loss in economies of scale into the costs of separation.

The existing literature on preventing separation carries a general consensus that the majority group must adjust national policies towards making them more favorable for the minority group threatening to secede (Buchanan and Faith [1987]; Bolton and Roland [1997]; Le Breton and Weber [2003]; Olofsgård [2004]; Haimanko et al. [2005]; Anesi [2012]). In contrast, this paper shows that secession can be prevented without the use of accommodating policies.

There are three typical responses to secessionist threats: one, a policy compromise to prevent the minority region from seceding; two, acceptance of the demand for independence leading to separation; three, fighting separatist movements resulting in armed conflict [Anesi and De Donder 2013]. A peaceful outcome can be achieved only if the majority offers terms which favor the minority [Radan 2007]. This paper diverges from the existing literature by describing an instrument in preventing secession which involves neither compromise nor armed conflict. It describes the use of public debt, a burden which has to be carried by both sides. This alternative creates efficiency costs for both the national government and the minority region but this does not involve resorting to war.

The idea that public debt can be used as a strategic instrument to influence the action of future decision makers is well established in other contexts of political economy (Persson and Svensson [1989]; Alesina and Tabellini [1990]; Tabellini and Alesina [1990]). The idea in this paper is closest to Aghion and Bolton [1990)] who show that there is a tendency for the incumbent to choose high levels of debt in order to remain in power. Debt is issued as a *strategic inefficiency* in the sense that it can be used by the ruling party to remain in office yet it carries efficiency costs for the whole country (also in Milesi-Ferretti and Spolaore [1994]; Milesi-Ferretti [1995]). In this paper, I describe debt as a *strategic inefficiency* in the context of secession. A high level of public debt can be issued in order to prevent secession, thus keeping the same decision-maker in place. In contrast to Aghion and Bolton [1990], the vote is made on whether one region will separate or stay with the country and not on which political party wins the national elections. If the region decides to secede, the power to make decisions for this region is shifted to another ruler overseeing the new, independent government. If it decides to stay, the national decision-maker keeps the authority to choose policies involving this region.

3. The model

Consider a two-period model with one country consisting of two regions, A and B, whose population sizes are N_A and N_B, respectively. Without loss of generality, let $N_A > N_B$. Region A is referred to as the majority region while region B is considered the minority region. The utility of each citizen is defined over the consumption of two public goods, x and y, expressed in per capita terms. Citizens within each region have homogeneous preferences. The utility of a citizen in region i can be represented as:

$$U_i = \Sigma_{t=1,2}\left[u_i\left(x_t\right)+v_i\left(y_t\right)\right], i = A, B \tag{1}$$

where x_t and y_t are per capita levels of x and y, respectively, chosen in period $t = 1$, 2. The price of each good is normalized to 1.

Citizens of the two regions have different preferences for x and y in the sense that

$$u'_A(x_t) > u'_B(x_t), \forall x_t > 0 \tag{2}$$

$$v'_A(y_t) < v'_B(y_t), \forall y_t > 0 \tag{3}$$

where $u'_i(x_t) > 0, u''_i(x_t) < 0$ and $v'_i(y_t) > 0, v''_i(y_t) < 0$ for $i = A, B$. In this case, region A has a stronger preference for good x than region B, while region B has a stronger preference for good y than region A[1].

In period 1, the country is organized as one democratic decision-making unit and under the assumption of majority voting rule, citizens in the majority region are decisive over the levels of consumption, x_1 and y_1. The country faces the following budget constraint:

$$x_1 + y_1 \leq 1 + d\,, \tag{4}$$

where per capita output endowment is fixed and normalized to 1 and $d \in [-1, \hat{d}]$ is the per capita level of public debt that the country can choose to incur in period 1. This debt will have to be fully repaid in period 2 so d cannot exceed a maximum amount $\hat{d} = \min\{1-c, 1-k\}$ where c and k will be defined shortly. This model assumes zero discounting and refers to public debt as a small country government's net borrowing from abroad. As such, this external debt cannot affect the world interest rate which is assumed to be equal to 0.

If the country remains united in period 2, the majority region remains decisive over the level and composition of spending, x_2^N and y_2^N. The country as a whole will face the following budget constraint in period 2:

$$x_2^N + y_2^N \leq 1 - d. \tag{5}$$

[1] The analytical results of this paper are preserved even if the difference in preferences is modeled in terms of relative preferences rather than absolute preferences.

If secession takes place, region B will obtain the right to choose its own levels of consumption in period 2, x_2^B and y_2^B. It will face the following budget constraint as an independent state:

$$x_2^B + y_2^B \leq 1 - d - k, \quad (6)$$

where $k \in (0, 1)$ represents the per capita cost of separation for the minority region. This cost accounts for the fact that a newly independent state will have to institute systems necessary for its own governance and the conduct of its own affairs. These systems include but are not limited to the formation of its own national defense, international relations, and general administration, among others.

On the other hand, the majority region's citizens will have to choose their respective levels of consumption, x_2^A and y_2^A, under the secession scenario. Region A's own budget constraint is given by

$$x_2^A + y_2^A \leq 1 - d - c, \quad (7)$$

where $c \in (0, 1)$ represents the per capita cost of separation for the majority region. This cost pertains to the loss in economies of scale arising from the fact that the fixed costs of running the country will be shared by a fewer number of citizens, resulting in an increase in the burden per capita.[2]

It is crucial to make the neutrality assumption that per capita burden of debt in period 2 remains fixed once it is set in period 1 and each citizen will have to carry the same value of liability whether secession takes place or the union remains intact. This assumption is necessary in order to keep the allocation of debt burden from contaminating the motivation to secede. It isolates the effect of difference in preferences between the two regions on the possibility of secession. For this reason, it is assumed that the share of debt burden per capita is equal to 1 for each citizen in each region whether the union is preserved or secession occurs[3].

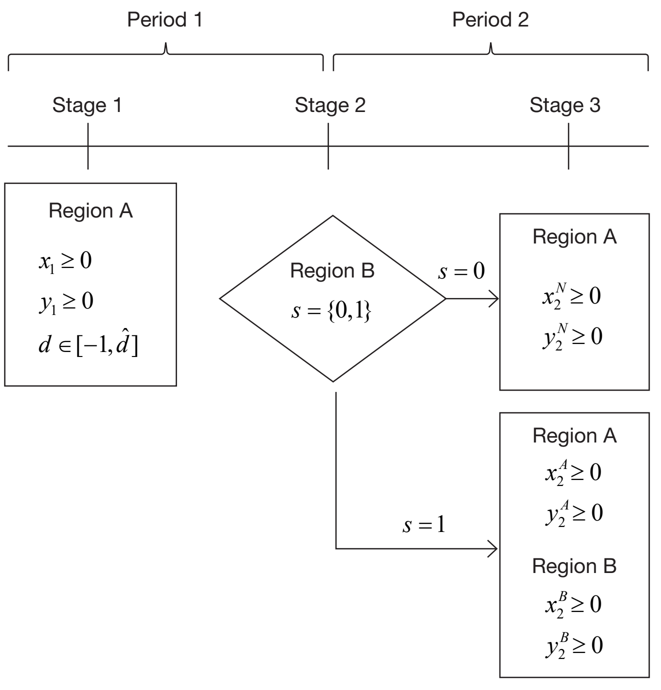
The model is a dynamic game with complete information and I am interested in the subgame-perfect Nash equilibrium (SPNE) in pure strategies. The sequence of the game is organized as follows and illustrated in Figure 1.

---

[2] The per capita cost of separation for each region, c and k, may also represent other losses associated with leaving a union. These losses include foregone benefits from keeping a union like interregional transfers (if the region is a net recipient of transfers) and the market size for domestic products (in a world of less than perfect international trade). These losses consist as well of the costs involved in the process of undergoing separation.

[3] If I relax this assumption and allow the minority region to carry less than its full share of per capita debt burden, the analytical results of this paper continue to hold as long as this region's share is sufficiently large. Moreover, if the minority region carries per capita debt burden larger than 1, then the analytical findings of this paper remain intact.

FIGURE 1. Sequence of the game



In period 1, region A chooses per capita consumption levels (x_1, y_1) as well as per capita debt level $d \in [-1, \hat{d}]$ for the whole country. This set of choices constitutes stage 1. Upon observing (x_1, y_1) and d, region B decides in stage 2 whether it will stay united with the country $\{s = 0\}$ or secede to form an independent state $\{s = 1\}$. If it chooses $s = 0$, then at stage 3, region A will choose period 2 consumption levels (x_2^N, y_2^N) subject to (5). If, on the other hand, region B chooses $s = 1$, then at stage 3 each region $i \in \{A, B\}$ independently chooses its consumption levels (x_2^i, y_2^i), given the budget constraints (7) and (6), respectively.

The minority region's utility level in period 2 is given by:

$$U_{B,2} = \begin{cases} u_B(x_2^N) + v_B(y_2^N), \; if \;\; s = 0 \\ u_B(x_2^B) + v_B(y_2^B), \; if \;\; s = 1. \end{cases}$$

The majority region's utility in the last period is characterized as:

$$U_{A,2} = \begin{cases} u_A(x_2^N) + v_A(y_2^N), \; if \;\; s = 0 \\ u_A(x_2^A) + v_A(y_2^A), \; if \;\; s = 1. \end{cases}$$

Finally, I assume the tie-breaking rule that region B chooses $s = 0$ (the union) if its period 2 utility levels under both scenarios are exactly the same.[4]

4. Equilibrium without threat of secession

Consider a benchmark case where there is no threat of secession. For this case, region A will choose the optimal consumption levels $(x_1^{*N},\ y_1^{*N})$ for period 1 and $(x_2^{*N},\ y_2^{*N})$ for period 2 that maximize its total utility (1) subject to the budget constraints (4) and (5). Its total payoff is given by

$$U_A^N = u_A(x_1^{*N}) + v_A(y_1^{*N}) + u_A(x_2^{*N}) + v_A(y_2^{*N}).$$

The optimal consumption levels must satisfy the following first-order condition (FOC):

$$u_A'(x_1^{*N}) = v_A'(y_1^{*N}) = u_A'(x_2^{*N}) = v_A'(y_2^{*N}),$$

which, in line with the consumption smoothing argument by Barro (1979), implies that

$$x_1^{*N} = x_2^{*N}$$

$$y_1^{*N} = y_2^{*N} \Rightarrow 1 + d^* - x_1^{*N} = 1 - d^* - x_2^{*N}.$$

This can be satisfied if and only if

$$d^* = 0 .$$

Thus, at the equilibrium where there is no threat of secession, the optimal level of debt is equal to zero.

5. Equilibrium with threat of secession

Consider now a game with threat of secession. To express region B's motivation to entertain the possibility of seceding, this game assumes that at $d = 0$, region B's period 2 utility level under secession is higher than its period 2 utility level under the union:

$$U_{B,2}(s = 1,\ d = 0) > U_{B,2}(s = 0,\ d = 0). \qquad \text{(a)}$$

To see whether issuing a specific amount of debt can influence the minority region's decision on secession, I solve the game by backward induction. At stage 3, the subgame depends on whether region B chooses $s = 0$ or $s = 1$ in stage 2.

[4] In order to focus on the effect of debt as a strategic instrument in preventing secession, this model also assumes that the majority region cannot credibly commit to other forms of pre-emptive mechanisms such as interregional transfers and accommodating policies in favor of the minority region. These are instruments already described in the existing literature on secession.

If $s = 0$, the subgame at stage 3 is characterized by provision of public goods at per capita levels x_2^{*N} and y_2^{*N} which maximize region A's period 2 utility

$$U_{A,2}^{N} = u_A(x_2^N) + v_A(y_2^N)$$

subject to

$$x_2^N + y_2^N \le 1 - d \,,$$

for any given debt level d chosen in stage 1 of the game. Using that

$$y_2^{*N} = 1 - d - x_2^{*N} \,,$$

the consumption levels $(x_2^{*N},\ y_2^{*N})$ satisfy the following FOC:

$$u'_A\,(x_2^{*N}) = v'_A\,(1 - d - x_2^{*N})\,. \tag{8}$$

Thus, region B's payoff in this outcome at stage 3 is given by

$$U_{B,2}\,(s = 0, d) = u_B\,(x_2^{*N}) + v_B\,(1 - d - x_2^{*N}) \tag{9}$$

for any given level of debt d.

If $s = 1$, the subgame at stage 3 for region B is characterized with provision of public goods at per capita levels x_2^{*B} and y_2^{*B} which maximize region B's period 2 utility $U_{B,2}^{S} = u_B\,(x_2^B) + v_B\,(y_2^B)$ subject to the minority region's budget constraint,

$$x_2^B + y_2^B \le 1 - d - k \,,$$

for any given level of debt d set by region A in period 1. Using that

$$y_2^{*B} = 1 - d - k - x_2^{*B} \,,$$

the consumption levels $(x_2^{*B},\ y_2^{*B})$ satisfy the following FOC:

$$u'_B\,(x_2^{*B}) = v'_B\,(1 - d - k - x_2^{*B})\,. \tag{10}$$

Thus, region B's payoff in this outcome at stage 3 is given by

$$U_{B,2}\,(s = 1, d) = u_B\,(x_2^{*B}) + v_B\,(1 - d - k - x_2^{*B})\,, \tag{11}$$

for any given level of debt d.

At stage 2, region B's option $s = 1$ dominates $s = 0$ if and only if

$$U_{B,2}\,(s = 1, d) > U_{B,2}\,(s = 0, d)\,. \tag{12}$$

As a result of the assumptions on preferences represented in (2) and (3), the optimal bundles of consumption in the two subgames differ in such a way that region B will always choose a lower consumption level of x_2 if it decides to secede,

$$x_2^{*N} > x_2^{*B} ,$$

while there are two possible directions for y_2. On one hand, region B prefers a higher consumption of y_2 compared to region A. On the other hand, the cost of secession k entails that region B's consumption of y_2 as an independent state may be lower than its consumption in a union. The first possibility dominates the second possibility, that is,

$$y_2^{*B} > y_2^{*N} , \tag{13}$$

only if k is sufficiently small:

$$k < x_2^{*N} - x_2^{*B} . \tag{b}$$

One necessary condition for region B to consider issuing a threat of secession is for (13) to be satisfied. Thus, the possibility of secession is a credible threat only if (b) holds.

5.1. The relationship between debt and preference mismatch

In a united situation, the majority region imposes its preferences on the minority region and allocates per capita income on the two public goods while applying its own consumption preferences. This implies that citizens in the minority region cannot make the best use of their income and, for a given income level, they suffer a utility loss compared to the optimal use of this income. In this subsection, I study how this utility loss changes with a change in per capita debt level, which is effectively a unit reduction in income. In order to establish this, I need the following notation:

Definition 1: Let $\Delta \equiv U_{B,2}(s=1,d) - U_{B,2}(s=0,d)$ be defined as region B's potential "gain from independence" or, equivalently, region B's utility loss associated with staying in the union, for any given level of debt d.

Region B optimally chooses $s = 1$ in stage 2 if $\Delta > 0$ and $s=0$ if $\Delta \leq 0$. Let us then examine the sensitivity of Δ with respect to public debt d. Substituting (9) and (11) into *Definition 1*, Δ can be expressed in terms of d as:

$$\Delta = u_B(x_2^{*B}) + v_B(1-d-k-x_2^{*B}) - u_B(x_2^{*N}) - v_B(1-d-x_2^{*N}) . \tag{14}$$

Let

$$\sigma_A(x) \equiv \frac{-u_A''(x)}{[u_A'(x)]^2} \tag{15}$$

represent the concavity index of region A's utility on good x, and let

$$\sigma_A(y) \equiv \frac{-v_A''(y)}{[v_A'(x)]^2} \tag{16}$$

represent the concavity index of region A's utility on good y, in accordance with Debreu and Koopmans' [1982] definition of concavity index. The following lemma establishes that, given a credible threat of secession, Δ is monotonically decreasing in the level of debt d under specific sufficient conditions involving the concavity of region A's utility and the total differentials of region B's utility.

Lemma 1 Suppose k satisfies (b). Then Δ is strictly decreasing in d if the following sufficient conditions are satisfied:

$$\text{(i) } \sigma_A(x) < \sigma_A(y), \qquad \forall x = y$$

$$\text{(ii) } u_B'(x_2^B) + v_B'(y_2^B) \geq u_B'(x_2^N) + v_B'(y_2^N), \qquad \forall x = y.$$

Proof See Appendix.

Condition (i) implies that region A's utility on its preferred good, x, must be less concave than its utility on its less-preferred good, y. This concavity condition implies that region A's marginal utility from its preferred good is decreasing at a slower rate than its marginal utility for the other good. This condition makes region A's optimal consumption path diverge farther away from the optimal consumption path of region B, as the consumption set increases. With debt, the available consumption set in period 2 effectively declines. More debt lowers the levels of consumption and brings region A's provision of public goods x_2^{*N}, y_2^{*N} closer to region B's preferred bundle x_2^{*B}, y_2^{*B}. Thus, higher levels of d correspond to lower gains from separation.

Condition (ii) implies that region B's marginal utility from an additional unit of x and an additional unit of y must be greater when it is independent than when it is united with region A. In this case, higher levels of debt will affect region B more adversely when it is separated than when it is part of the union.

With *Lemma 1*, I consider the minority region's decision in stage 2 on whether to separate or not. This decision can be characterized as follows.

Proposition 1 Suppose (a) holds and k satisfies (b). Suppose further that conditions (i) and (ii) are satisfied. Then there exists a unique threshold debt level $\overline{d} \in (0, 1-k)$ such that region B's optimal choice at stage 2 is $s^* = 0$ if and only if $d \geq \overline{d}$.

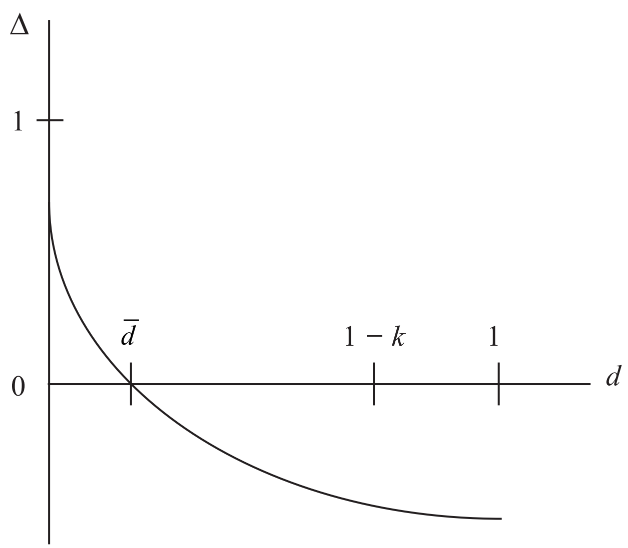
Proof First note that Δ is continuous in d everywhere, by the continuity of $u_i(x_t)$ and $v_i(y_t)$. At $d = 0$, $\Delta > 0$ if (a) holds. By Lemma 1, Δ is strictly decreasing in d if k satisfies (b) and conditions (i) and (ii) hold. At $d = 1 - k$, $\Delta < 0$ since $x_2^{*B} = 0$ and $y_2^{*B} = 0$ for $s = 0$ while $x_2^{*N} \geq 0$ and $y_2^{*N} \geq 0$ with at least one equation being a strict inequality for $s = 1$. The assumptions $u_i'(x_t) > 0$ and $v_i'(y_t) > 0$ ensure that $U_{B,2}(s = 1, d = 1 - k) = u_B(0) + v_B(0) < U_{B,2}(s = 0, d = 1 - k) = u_B(x_2^{*N}) + v_B(y_2^{*N})$. Hence, by the Intermediate Value Theorem, there exists a unique $d \in (0, 1 - k)$ satisfying $\Delta(\bar{d}) = 0$. □

Region B's decision on whether to stay together with region A or to separate follows a threshold rule. There is exactly one level of debt $\bar{d}$ that makes region B indifferent about whether to secede or not. For levels of debt exceeding this threshold, region B prefers to stay in the union, and for levels of debt below this threshold, region B prefers to separate. This condition determines the non-separation constraint (NSC), by which region B chooses $s^* = 0$ in stage 2 if region A sets debt level d in stage 1 such that

$$d \geq \bar{d}. \qquad (c)$$

Figure 2 illustrates that if the potential gain from independence is monotonically decreasing in debt, region B will always prefer to stay in the union once debt crosses the threshold level $\bar{d}$.

FIGURE 2. Potential gain from independence as a function of the debt level



5.2. An example

The following example illustrates that when the potential gain from independence is monotonically declining in debt, there exists a threshold level of debt $\bar{d}$ which can be used to prevent the minority region from seceding.

Let $U_A = \sum_{t=1,2}\left(\beta\sqrt{x_t} + \sqrt{y_t}\right)$ and $U_B = \sum_{t=1,2}\left(\sqrt{x_t} + \gamma\sqrt{y_t}\right)$, where $\beta, \gamma > 1$. This example satisfies the model assumptions in (2) and (3). If the country remains united in period 2, the consumption levels of *x* and *y* that region *A* will choose for the country are given by

$$x_2^{*N} = [\beta^2/(\beta^2+1)][1-d], \quad y_2^{*N} = [1/(\beta^2+1)][1-d].$$

On the other hand, if region *B* decides to secede, its period 2 consumption levels will be equal to

$$x_2^{*B} = [1/(\gamma^2+1)][1-d-k], \quad y_2^{*B} = [\gamma^2/(\gamma^2+1)][1-d-k].$$

Region *B*'s potential gain from independence is given by

$$\Delta = \sqrt{\frac{1}{\gamma^2+1}(1-d-k)} + \gamma\sqrt{\frac{\gamma^2}{\gamma^2+1}(1-d-k)} - \sqrt{\frac{\beta^2}{\beta^2+1}(1-d)} - \gamma\sqrt{\frac{1}{\beta^2+1}(1-d)}.$$

The total effect of debt on Δ, $d\Delta/dd$, is strictly negative if

$$(\beta+\gamma)^2/(\gamma^2+1)(\beta^2+1) < (1-d)/(1-d-k),$$

a condition that is always satisfied given that β, $\gamma > 1$ and $k > 0$. Thus, in this example, region *B*'s potential gain from independence is monotonically decreasing in debt. By Proposition 1, there exists a unique threshold level of debt $\bar{d}$ such that region *B* will choose to stay in the union if region *A* sets the public debt level $d \geq \bar{d}$. This threshold level is given by

$$\bar{d} = 1 - Mk, \qquad (17)$$

where

$$M \equiv [(\gamma^2+1)(\beta^2+1)]/[(\gamma^2+1)(\beta^2+1) - (\beta+\gamma)^2].$$

With any debt level greater than or equal to $\bar{d} = 1 - Mk$, region *B*'s potential gain from independence, Δ, becomes non-positive. Thus, region *B* chooses to stay in the union if debt is set at least equal to $\bar{d}$.

6. The decision of the majority region

In this section, I examine the majority region's equilibrium choice of public debt. Using backward induction, I first describe region *A*'s total payoff at the end of the game for any given level of debt *d* that it sets in period 1.

Region *A* enters one of two possible subgames at stage 3. If region *B* chooses $s = 0$ at stage 2, then region *A* enters the non-secession subgame at stage 3. In this subgame, region *A* chooses the consumption levels for periods 1 and 2 that maximize its total utility (1) subject to the budget constraints (4) and (5) and the non-separation constraint in (*c*). Let λ be the Lagrange multiplier for the inequality constraint (*c*). This constraint is binding so $\lambda > 0$ and the optimal consumption levels $(\overline{x}_1^{*N}, \overline{y}_1^{*N}, \overline{x}_2^{*N}, \overline{y}_2^{*N})$ satisfy the FOCs:

$$u'_A(\overline{x}_1^{*N}) = v'_A(\overline{y}_1^{*N}) = u'_A(\overline{x}_2^{*N}) - \lambda = v'_A(\overline{y}_2^{*N}) - \lambda$$

and

$$d = \overline{d}\ .$$

These conditions are satisfied simultaneously by the optimal choice of debt,

$$d^{*N} = \overline{d}\ .$$

Thus, region *A*'s total payoff in this subgame is equal to

$$U_A^*(s = 0, d^{*N} = \overline{d}) = u_A(\overline{x}_1^{*N}) + v_A(\overline{y}_1^{*N}) + u_A(\overline{x}_2^{*N}) + v_A(\overline{y}_2^{*N})\ .$$

If region *B* chooses $s = 1$ at stage 2, then region *A* enters the secession subgame at stage 3. In this subgame, region *A* chooses the consumption levels for periods 1 and 2 that maximize its total utility (1) subject to budget constraints (4) and (7). The optimal consumption levels $\left(x_1^{*S},\ y_1^{*S},\ x_2^{*A},\ y_2^{*A}\right)$ satisfy the FOC:

$$u'_A(x_1^{*S}) = v'_A(y_1^{*S}) = u'_A(x_2^{*A}) = v'_A(y_2^{*A})\ .$$

Thus,

$$x_1^{*S} = x_2^{*A}$$

$$y_1^{*S} = y_2^{*A} \Rightarrow 1 + d - x_1^{*S} = 1 - d - c - x_2^{*A}\ .$$

Region *A*'s optimal choice of debt in this subgame is

$$d^{*S} = -\,c/2\ .$$

Region A should *save* in period 1 in order to smooth its consumption over the two periods. Its total payoff in this subgame is

$$U_A^*(s=1, d^{*S}=-c/2) = u_A(x_1^{*S}) + v_A(y_1^{*S}) + u_A(x_2^{*A}) + v_A(y_2^{*A}).$$

The subgame-perfect Nash equilibrium of this game depends on whether or not this condition is satisfied:

$$U_A^S(s=0, d^{*N}=\bar{d}) \geq U_A^S(s=1, d^{*S}=-c/2) \quad (e).$$

7. The optimal debt and secession decisions

Taking together the optimal decisions of regions A and B at each stage of the game, I now characterize the subgame-perfect Nash equilibrium. I show that this game has one unique equilibrium. This equilibrium can be one of two types: one where region A issues a specific level of debt sufficient to keep region B from separating and another where region A chooses to keep savings in period 1 and region B decides to secede at stage 2. When conditions that support the first type of equilibrium are fulfilled, public debt acts as a strategic instrument in preserving the union. Otherwise, secession occurs.

Proposition 2 *Suppose $d\Delta / dd < 0$. If (e) holds, then in the subgame perfect equilibrium region A sets $d^* = \bar{d}$ and region B optimally chooses $s^* = 0$. Otherwise, if (e) does not hold, then in the subgame perfect equilibrium region A sets $d^* = -c/2$ and region B optimally chooses $s^* = 1$.*

Proof By backward induction, region A sets $d^* = \bar{d}$ at stage 1 if and only if (e) holds. By *Proposition 1*, region B chooses $s^* = 0$ at stage 2 if $d \geq \bar{d}$, given $d\Delta / dd < 0$. On the other hand, if (e) does not hold, then by backward induction, region A sets $d^* = -c/2$ at stage 1. Because $d^* = -c/2$ does not satisfy the non-separation constraint expressed in (c), then at stage 2 Region B chooses $s^* = 1$. □

Proposition 2 implies that, for the union to be preserved using public debt, region A must be better off in a union with debt $\bar{d}$ than as a separate state with savings equal to half of its own separation cost.

To illustrate the trade-off in (e), I revisit the parametrization of utility in the previous example and characterize the equilibrium as follows.

7.1. Example

Given $U_A = \sum_{t=1,2}\left(\beta\sqrt{x_t} + \sqrt{y_t}\right)$, region A has the option to set $d^{*N}=\bar{d}$ and obtain consumption levels in periods 1 and 2 equal to

$$\bar{x}_1^{*N} = [\beta^2/(1+\beta^2)][1+\bar{d}], \quad \bar{y}_1^{*N} = [1/(1+\beta^2)][1+\bar{d}]$$

$$\bar{x}_2^{*N} = [\beta^2/(1+\beta^2)][1-\bar{d}], \quad \bar{y}_2^{*N} = [1/(1+\beta^2)][1-\bar{d}].$$

In this case, region A will end up with total payoff

$$U_A^*(s=0, d^{*N}=\bar{d}) = \beta\sqrt{\bar{x}_1^{*N}} + \sqrt{\bar{y}_1^{*N}} + \beta\sqrt{\bar{x}_2^{*N}} + \sqrt{\bar{y}_2^{*N}}\,. \tag{18}$$

On the other hand, if region A sets $d^{*S} = -c/2$, its optimal consumption bundle for periods 1 and 2 is given by

$$x_1^{*S} = [\beta^2/(1+\beta^2)][1-c/2)], \quad y_1^{*S} = [1/(1+\beta^2)][1-c/2]$$

$$x_2^{*A} = [\beta^2/(1+\beta^2)][1-c/2)], \quad y_2^{*A} = [1/(1+\beta^2)][1-c/2].$$

Its total payoff by the end of the game is characterized as:

$$U_A^*(s=1, d^{*S} = -[c/2]) = \beta\sqrt{x_1^{*S}} + \sqrt{y_1^{*S}} + \beta\sqrt{x_2^{*A}} + \sqrt{y_2^{*A}}\,. \tag{19}$$

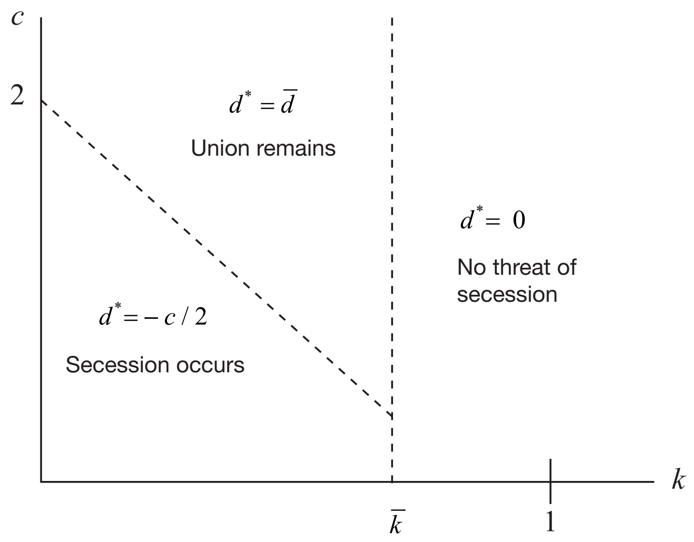
Region A will optimally choose to pre-empt secession using debt if (e) holds. Plugging in the payoffs (18) and (19) into (e), I find that in this example, region A will optimally choose to preserve the union as long as the threshold debt level is sufficiently small:

$$\bar{d} \le c/2\,.$$

With the threshold debt level given by (17), region A uses debt in equilibrium if and only if $c \ge 2 - 2Mk$.

Figure 3 illustrates the equilibrium in this example for given costs ofseparation, c and k. In this figure, $\bar{k} = x_2^{*N} - x_2^{*B}$ represents the dividing line between a credible threat of secession and the benchmark case where there is no threat of secession.

FIGURE 3. Equilibrium at given levels of separation costs, c and k



7.2. Comparative statics

Consider an increase in c holding all other variables fixed. Region A's utility as a separate state with savings shifts downwards, i.e., $U_A^*(s=1, d^{*S} = -c/2)$ is smaller, if c is higher. The right-hand side of (e) decreases if c increases. Thus, a subgame perfect equilibrium in which the union is preserved using public debt $(s^* = 0, d^* = \bar{d})$ is supported by high costs of separation for region A.

Now consider the effect of a marginal change in k, holding all other variables fixed. Region B's cost of separation k affects the subgame perfect equilibrium through its effect on the threshold debt level $\bar{d}$. Region A's utility under the union is (weakly) decreasing in $\bar{d}$ because if a higher threshold level of debt is needed to prevent secession, the intertemporal distortion arising from consumption unsmoothing will also be higher. The left-hand side of (e) weakly decreases as $\bar{d}$ increases. However, $\bar{d}$ is decreasing in region B's cost of separation k. Higher values of k are associated with lower levels of $\bar{d}$ because less debt is necessary to match the low benefits from independence that can be gained when the cost of separation is high. Because lower levels of $\bar{d}$ translate into higher utility for region A in a united situation, the overall effect of k on the union's preservation is positive. Thus, a higher cost of separation for region B supports the subgame perfect equilibrium where the union is saved using debt as a strategic instrument.

8. Concluding remarks

This paper demonstrates that public debt can be used as a strategic instrument in preventing secession. This argument differs from the notion that a high level of government debt intensifies the possibility of separation and adds to political instability in general. While this paper does not discount this notion, it establishes that there is a strategic mechanism through which the effect of debt acts in the direction of preserving a country's unity.

This counter-intuitive argument is brought forth by identifying micro foundations behind the decision on secession. Difference in preferences is recognized as the fundamental motivation behind a minority region's possibility of calling for independence. The potential gain from independence that this region can achieve through secession arises from utility gains in choosing consumption bundles according to its own preferences. This paper specifies that the potential gain from independence may be affected by debt. More specifically, the potential gain from independence can be monotonically decreasing in debt.

The property of decreasing gain from independence is central in this argument. If this property holds, then by raising the debt level, the national government can influence the minority region's decision on secession because higher debt levels leave the seceding region with fewer gains from separation. This paper proves that the debt level can be set high enough to induce the minority region to stay in the union.

Given that the gain from independence is decreasing in debt, it is in the best interest of the majority region to set public debt at a strategically high level and thus pre-empt secession if it finds itself better off in a united country carrying this debt than as a separate state with some savings. This is more likely the case if its own cost of separation is high.

The issuance of public debt for the purpose of preventing secession makes it a *strategic inefficiency*. It is *inefficient* in the sense that it distorts the intertemporal path of public spending and creates efficiency costs by so doing. Nonetheless, it is *strategic* in the sense that it can influence the secession outcome towards preserving a country's unity. The findings of this paper imply that the very presence of a secession threat may create a tendency for the country to set an inefficiently high level of debt for the strategic purpose of keeping itself intact.

Acknowledgements: I thank Kai A. Konrad, Florian Morath, Aart Gerritsen, Tim Stolper, Michael Hilmer, Luca Salvadori, Raul Fabella, Matthias Dahm, Trond Olsen, Qiang Fu, Andreas Haufler, and participants at the Public Economics Seminar of the Ludwig-Maximilians-University in Munich for helpful comments and suggestions.

References

Aghion, P. and P. Bolton [1990] "Government domestic debt and the risk of default: a political-economic model of the strategic role of debt", *Public Debt Management: Theory and History*, 315.

Alesina, A. and R. Perotti [1995] "The political economy of budget deficits", *IMF Staff Papers* 42(1): 1-31.

Alesina, A, R. Perotti, and E. Spolaore [1995] "Together or separately? Issues on the costs and benefits of political and fiscal unions", *European Economic Review* 39(3): 751-758.

Alesina, A. and E. Spolaore [1997] "On the number and size of nations", *The Quarterly Journal of Economics* 112(4): 1027-1056.

Alesina, A. and E. Spolaore [2005] "War, peace, and the size of countries", *Journal of Public Economics* 89(7): 1333-1354.

Alesina A., E. Spolaore, and R. Wacziarg [2000] "Economic integration and political disintegration", *The American Economic Review* 90(5): 1276-1296.

Alesina A. and G. Tabellini [1990] "A positive theory of fiscal deficits and government debt", *The Review of Economic Studies* 57(3): 403-414.

Anesi, V. [2012] "Secessionism and minority protection in an uncertain world", *Journal of Public Economics* 96(1): 53-61.

Anesi, V. and P. De Donder [2013] "Voting under the threat of secession: accommodation versus repression", *Social Choice and Welfare* 41(2): 241-261.

Barro, R. J. [1979] "On the determination of the public debt", *The Journal of Political Economy* 87(5, Part 1): 940-971.

Bolton P. and G. Roland [1997] "The breakup of nations: a political economy analysis", *The Quarterly Journal of Economics* 112(4): 1057-1090.

Buchanan, J. M. and R. L. Faith [1987] "Secession and the limits of taxation: toward a theory of internal exit", *The American Economic Review* 77(5): 1023-1031.

Casella, A. [1992] "On markets and clubs: economic and political integration of regions with unequal productivity", *The American Economic Review* 82(2): 115-121.

Casella, A. and J. S. Feinstein [2002] "Public goods in trade: on the formation of markets and jurisdictions", *International Economic Review,* 43(2): 437-462.

Debreu, G. and T. C. Koopmans [1982] "Additively decomposed quasiconvex functions", *Mathematical Programming* 24(1): 1-38.

Haimanko, O., M. Le Breton, and S. Weber [2005] "Transfers in a polarized country: bridging the gap between efficiency and stability", *Journal of Public Economics* 89(7): 1277-1303.

Le Breton, M. and S. Weber [2003] *The art of making everybody happy: how to prevent a secession. IMF Staff Papers* 50(3): 403-435.

Milesi-Ferretti, G. M. [1995] "Do good or do well? Public debt management in a two-party economy", *Economics & Politics* 7(1): 59-78.

Milesi-Ferretti, G. M., and E. Spolaore [1994] "How cynical can an incumbent be? strategic policy in a model of government spending", *Journal of Public Economics* 55(1): 121-140.

Olofsgård, A. [2004] "Secessions and political extremism: why regional referenda do not solve the problem", *Journal of the European Economic Association* 2(5): 805-832.
Persson, T. and L. E. Svensson [1989] "Why a stubborn conservative would run a deficit: policy with time-inconsistent preferences", *The Quarterly Journal of Economics* 104(2): 325- 345.
Radan, P. [2007] *Creating new states: theory and practice of secession.* Ashgate Publishing, Ltd.
Ruta, M. [2005] "Economic theories of political (dis)integration", *Journal of Economic Surveys* 19(1): 1-21.
Tabellini, G. and A. Alesina [1990] "Voting on the budget deficit", *The American Economic Review* 80(1): 37-49.

Appendix

Proof of Lemma 1. Conditions that satisfy $d\Delta / dd < 0$ need to be identified. First, the potential "gain from independence" in Definition 1 can be expressed as $\Delta = u_B(x_2^{*B}) + v_B(y_2^{*B}) - u_B(x_2^{*N}) - v_B(y_2^{*N})$.

The effect of d on Δ is given by

$$\frac{d\Delta}{dd} = \frac{\partial u_B(x_2^{*B})}{\partial x_2^{*B}} \cdot \frac{\partial x_2^{*B}}{\partial d} \cdot \frac{\partial v_B(y_2^{*B})}{\partial y_2^{*B}} \cdot \frac{\partial y_2^{*B}}{\partial d} - \frac{\partial u_B(x_2^{*N})}{\partial x_2^{*N}} \cdot \frac{\partial x_2^{*N}}{\partial d} - \frac{\partial v_B(y_2^{*N})}{\partial y_2^{*N}} \cdot \frac{\partial y_2^{*N}}{\partial d}.$$

By the FOC in (10),

$$\frac{d\Delta}{dd} = u'_B(x_2^{*B})\left[\frac{\partial x_2^{*B}}{\partial d} + \frac{\partial y_2^{*B}}{\partial d}\right] - u'_B(x_2^{*N}) \cdot \frac{\partial x_2^{*N}}{\partial d} - v'_B(y_2^{*N}) \cdot \frac{\partial y_2^{*N}}{\partial d}.$$

Through implicit differentiation,

$$\frac{\partial x_2^{*B}}{\partial d} + \frac{\partial y_2^{*B}}{\partial d} = \frac{v''_B(y_2^{*B})}{u''_B(x_2^{*B}) + v''_B(y_2^{*B})} - \frac{u''_B(x_2^{*B})}{u''_B(x_2^{*B}) + v''_B(y_2^{*B})} = -1,$$

$$\frac{\partial x_2^{*N}}{\partial d} = -\frac{v''_A(y_2^{*N})}{u''_A(x_2^{*N}) + v''_A(y_2^{*N})},$$

$$\frac{\partial y_2^{*N}}{\partial d} = -\frac{u''_A(x_2^{*N})}{u''_A(x_2^{*N}) + v''_A(y_2^{*N})},$$

therefore,

$$\frac{d\Delta}{dd} = u'_B(x_2^{*B}) - u'_B(x_2^{*N})\left[-\frac{v''_A(y_2^{*N})}{u''_A(x_2^{*N}) + v''_A(y_2^{*N})}\right] - v'_B(y_2^{*N})\left[-\frac{u''_A(x_2^{*N})}{u''_A(x_2^{*N}) + v''_A(y_2^{*N})}\right].$$

This can be summarized as

$$\frac{d\Delta}{dd}=\frac{u''_A(x_2^{*N})\ [v'_B(y_2^{*N})-u'_B(x_2^{*B})]+v''_A(y_2^{*N})\ [u'_B(x_2^{*N})-u'_B(x_2^{*B})]}{u''_A(x_2^{*N})+v''_A(y_2^{*N})}.$$

After dividing both numerator and denominator by $-u'_A(x_2^{*N})\,v'_A(y_2^{*N})$ it follows that $d\Delta/dd<0$ iff

$$\frac{-\frac{u''_A(x_2^{*N})}{u'_A(x_2^{*N})}\cdot\frac{1}{v'_A(y_2^{*N})}[v'_B(y_2^{*N})-u'_B(x_2^{*B})]-\frac{v''_A(y_2^{*N})}{v'_A(y_2^{*N})}\cdot\frac{1}{u'_A(x_2^{*N})}[u'_B(x_2^{*N})-u'_B(x_2^{*B})]}{-\frac{u''_A(x_2^{*N})}{u'_A(x_2^{*N})\,v'_A(y_2^{*N})}-\frac{v''_A(y_2^{*N})}{u'_A(x_2^{*N})\,v'_A(y_2^{*N})}}<0.$$

This is equivalent to

$$\frac{R(x_2^{*N})\cdot\frac{1}{v'_A(y_2^{*N})}[v'_B(y_2^{*N})-u'_B(x_2^{*B})]+R(y_2^{*N})\cdot\frac{1}{u'_A(x_2^{*N})}[u'_B(x_2^{*N})-u'_B(x_2^{*B})]}{\frac{R(x_2^{*N})}{v'_A(y_2^{*N})}+\frac{R(y_2^{*N})}{u'_A(x_2^{*N})}}<0,$$

where

$$R(x_2^{*N})=-\frac{u''_A(x_2^{*N})}{u'_A(x_2^{*N})},$$

$$R(y_2^{*N})=-\frac{v''_A(y_2^{*N})}{v'_A(y_2^{*N})}.$$

Using FOCs in (8) and (10), $d\Delta/dd<0$ iff

$$\frac{\frac{R(x_2^{*N})}{u'_A(x_2^{*N})}[v'_B(y_2^{*N})-v'_B(y_2^{*B})]+\frac{R(y_2^{*N})}{v'_A(y_2^{*N})}[u'_B(x_2^{*N})-u'_B(x_2^{*B})]}{\frac{R(x_2^{*N})}{u'_A(x_2^{*N})}+\frac{R(y_2^{*N})}{v'_A(y_2^{*N})}}<0.$$

Let

$$\sigma_A(x_2^{*N})\equiv\frac{R(x_2^{*N})}{u'_A(x_2^{*N})}=-\frac{u''_A(x_2^{*N})}{[u'_A(x_2^{*N})]^2},$$

$$\sigma_A(y_2^{*N})\equiv\frac{R(y_2^{*N})}{v'_A(y_2^{*N})}=-\frac{v''_A(y_2^{*N})}{[v'_A(y_2^{*N})]^2}.$$

Then, $d\Delta / dd < 0$ iff

$$\frac{\sigma_A(x_2^{*N})[v'_B(y_2^{*N}) - v'_B(y_2^{*B})] + \sigma_A(y_2^{*N})[u'_B(x_2^{*N}) - u'_B(x_2^{*B})]}{\sigma_A(x_2^{*N}) + \sigma_A(y_2^{*N})} < 0,$$

where $\sigma_A(x_2^{*N}) > 0$, $\sigma_A(y_2^{*N}) > 0$. This is equivalent to

$$\sigma_A(x_2^{*N})[v'_B(y_2^{*N}) - v'_B(y_2^{*B})] < \sigma_A(y_2^{*N})[u'_B(x_2^{*B}) - u'_B(x_2^{*N})]. \quad (f)$$

By the assumption in (2), $x_2^{*N} > x_2^{*B}$, so that the following is always satisfied given that $u_B(x_t)$ is concave: $u'_B(x_2^{*B}) - u'_B(x_2^{*N}) > 0$.

The assumption in (3) and the credible threat of secession given by (*b*) imply that $y_2^{*B} > y_2^{*N}$. Thus, by (3), (*b*), and the concavity of $v_B(y_t)$,

$$v'_B(y_2^{*N}) - v'_B(y_2^{*B}) > 0.$$

If $u'_B(x_2^B) + v'_B(y_2^B) \geq u'_B(x_2^N) + v'_B(y_2^N)$

for all $x_2^B = x_2^N = y_2^B = y_2^N$,

then at $x_2^B = x_2^{*B}$, $x_2^N = x_2^{*N}$, $y_2^B = y_2^{*B}$, $y_2^N = y_2^{*N}$,

it follows that $u'_B(x_2^{*B}) + v'_B(y_2^{*B}) \geq u'_B(x_2^{*N}) + v'_B(y_2^{*N})$.

Equivalently, $u'_B(x_2^{*B}) - u'_B(x_2^{*N}) \geq v'_B(y_2^{*N}) - v'_B(y_2^{*B})$.

Let $\sigma_A(x)$ and $\sigma_A(y)$ be as defined in (15) and (16), respectively. If $\sigma_A(x) < \sigma_A(y)$ for all $x = y$, then at $x = x_2^{*N}$ and $y = y_2^{*N}$ with $x_2^{*N} = y_2^{*N}$, it follows that $\sigma_A(x_2^{*N}) < \sigma_A(y_2^{*N})$.

Thus, (*f*) is guaranteed by the following sufficient conditions:

$$\text{(i)} \ \sigma_A(x) < \sigma_A(y), \qquad \forall \ x = y$$

$$\text{(ii)} \ u'_B(x_2^B) + v'_B(y_2^B) \geq u'_B(x_2^N) + v'_B(y_2^N), \qquad \forall \ x_2^B = x_2^N = y_2^B = y_2^N.$$

Hence, $d\Delta / dd < 0$ if k satisfies *(b)* and the sufficient conditions (i) and (ii) are satisfied. □

The Philippine Economic Society

Founded 1961

The Philippine Economic Society (PES) was established in August 1962 as a nonstock, nonprofit professional organization of economists.

Over the years, the PES has served as one of the strongest networks of economists in the academe, government, and business sector.

Recognized in the international community of professional economic associations and a founding member of the Federation of ASEAN Economic Associations (FAEA), the PES continuously provides a venue for open and free discussions of a wide range of policy issues through its conferences and symposia.

Through its journal, the *Philippine Review of Economics* (PRE), which is jointly published with the UP School of Economics, the Society performs a major role in improving the standard of economic research in the country and in disseminating new research findings.

At present the society enjoys the membership of some 800 economists and professionals from the academe, government, and private sector.

- Lifetime Membership – Any regular member who pays the lifetime membership dues shall be granted lifetime membership and shall have the rights, privileges, and responsibilities of a regular member, except for the payment of the annual dues.
- Regular Membership – Limited to individuals 21 years of age or older who have obtained at least a bachelor's degree in economics, or who, in the opinion of the Board of Directors, have shown sufficient familiarity and understanding of the science of economics to warrant admission to the Society. Candidates who have been accepted shall become members of the Society only upon payment of annual dues for the current year.
- Junior Membership – This is reserved for full-time college or graduate students majoring in economics. Affiliation for junior membership is coursed through the Junior Philippine Economic Society (JPES).

For more information, visit: www.phileconsociety.org.

Volume LVI Nos. 1 and 2 THE PHILIPPINE REVIEW OF ECONOMICS June and December 2019