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ON COOPERATION IN MUSGRAVIAN MODELS OF EXTERNALITIES WITHIN A FEDERATION

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Abstract

"Musgravian" externalities, formulated and illustrated by Musgrave in a 1966 paper on "social goods" are seen in this paper as one form of the interactions that occur between the components of a federation. The original formal apparatus is first exposed briefly. In that context, it is then considered whether and how alternative forms of federal structures are likely to achieve efficiency. Following suggestions from the literature, three such forms are dealt with: "planned", "cooperative" and "majority rule" federalisms. Next, the relevance of non cooperative equilibria is examined, in the light of an interpretation of them as "fall back" positions when disagreement occurs among members of a federation. Finally, the question is evoked of what economics and public finance may have to say on the limits to institutional decentralization, *i.e.* on the choice between federal, confederal and secessional structures. The paper concludes with a reminder of Musgrave's view on this issue.

JEL Classification: D7, H1, H7.

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Outline

1. Introduction

In my home country Belgium, cooperation between federated entities has become of vital importance — vital in the very first sense of the word. While the Belgian State is by now 170 years old, the Belgian federation is in fact very young: only ten years, even a little less. And the federalisation process being a decentralizing (some people say centrifugal) one, the issue comes up sometimes: why is it a State, after all?

This is my motivation for the topic I chose for this talk. I realize that speaking of this here, in a country where just the reverse did occur ten years ago with the reunification, may seem inappropriate.

But the celebration we are in invites to a thinking of general nature. By having written the first treatise entitled *Theory of Public Finance*, Richard Musgrave has brought the general language of economic theory into public finance and he thereby pionneered a new way to cover the field. Following that example, I have endeavoured to cover my subject matter in as general a way as I can.

Starting from some description of the interactions that occur within the components of a federation and from a characterization of the efficient amount of such interactions (Section 2), I move to the pretty classical issue of how to achieve that efficiency in a federal framework, under alternative institutional settings (Section 3). Leaving aside efficiency, I consider non cooperative

equilibria, and evaluate their interest in a federal context (Section 4). While considering further steps of decentralization, I cannot escape the issue of a federation's dismantling and ask the question of what public finance theory can tell us about that extreme case (Section 5). I conclude in a Musgravian spirit (Section 6).

2. Describing interactions and optimality in the presence of externalities

Interactions between juridictions may be represented in many different ways. For the present occasion, I find it justified to make use of one such representation actually due to Richard Musgrave (published as Musgrave 1969). It was not designed for the study of federalism, but instead for a discussion on the nature of public goods, and a lively exchange took place on that basis between Richard and Paul Samuelson at an IEA Conference in Biarritz, France in 1966 for which the paper had been prepared. I do not plan to reopen that discussion[2] here, but well to exploit two diagrams presented by Richard in the paper.

There are two economic agents A and B, who are not identified explicitly in the paper as individuals, or as political parties, or as regions in a federation, but later in this paper I shall retain this last interpretation.

Each agent's preferences are described by a preference function $U_A(...)$ and $U_B(...)$ whose arguments are:

(i) some standard private good X — thus, X_A and X_B for A and B respectively;
(ii) another good denoted Y, that generates an externality on the other agent.

The purpose of Musgrave's Biarritz paper was, to a large extent, to describe and characterize several alternative forms of the externality conveyed by Y, and to compare these forms with the concept of public good in the strict Samuelsonian sense. I select here two[3] of these forms. One is called by the author the case of

[2] Let me only suggest to have a look at the record of it, which takes twelve pages of small font text in the proceedings book!
[3] I skip the many other cases expounded in the paper, as my purpose here is not to go and discuss the taxonomy of externalities and public goods.

"Non Substitute Externalities" and is expressed as follows in terms of the arguments of the preference functions of A and B :

$$U_A(X_A, Y_A, Y_B) \qquad \text{and} \qquad U_B(X_B, Y_B, Y_A).$$

Another case is called the one of "Mixed Benefit Goods", expressed as

$$U_A(X_A, Y_A, Y_A + Y_B) \qquad \text{and} \qquad U_B(X_B, Y_B, Y_A + Y_B).$$

In the first case, good Y produced by A is like a public good for B, since he consumes it in equal amounts as A . If there were several agents, *C, D,* ..., with Y_A entering their utility function just as it is the case for B, Y_A would be a standard Samuelsonian public good. A similar argument can be made for Y_B , *mutatis mutandis,* which is also a (different) public good.

In the second case, Y_A and Y_B are in fact the same physical commodity, provided for by both A and B, and whose sum has the virtue of being a Samuelsonian public good[4].

With the help of two sets of diagrams, Richard determines the optimality conditions for the supply of the externality generating good Y as appears on Figures 1 and 2. Thus, we have that at an optimum in the first figure agent A produces and consumes OL of Y_A and agent B produces and consumes OG of Y_B . In the case of the second figure, the efficient total production of Y is OE, with OH produced by A and HE produced by B (Richard is not too clear on what the respective supply curves are in this case..., but this is unimportant to capture the essence of the argument).

[4] In my joint work with Parkash Chander, dealing with international environmental problems, I have made extensive use of this formulation, using the term of "environmental externalities" (Chander and Tulkens 1995, 1997). The first of these references was built on a variant found in Mäler 1989. The model is still in use today in further applications to climate change issues (see *e.g.* Germain, Toint, Tulkens and de Zeeuw 1999). Another instance of use of a model in that same spirit is the one ereferred to in footnote 2 of Ostrom 2000, a paper to which we shall refer again below.

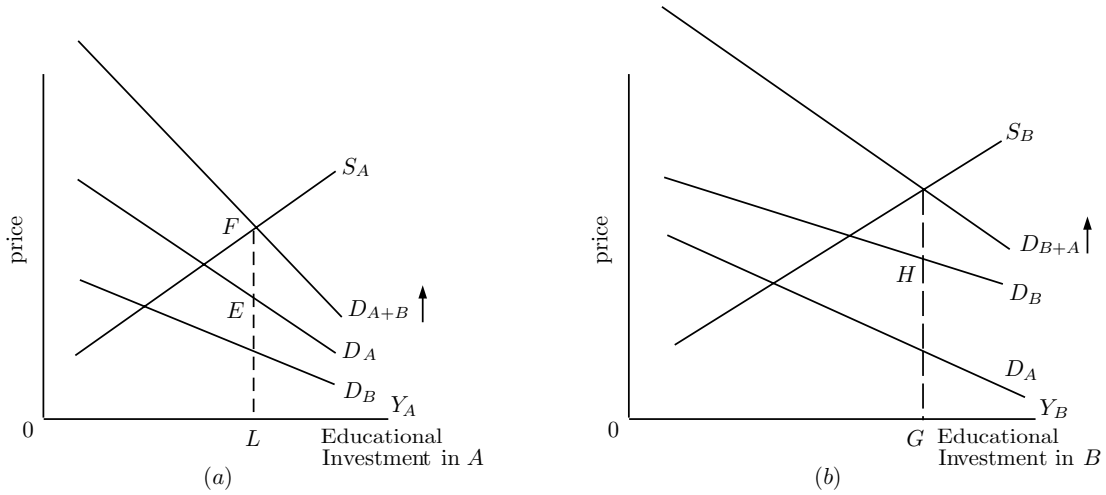
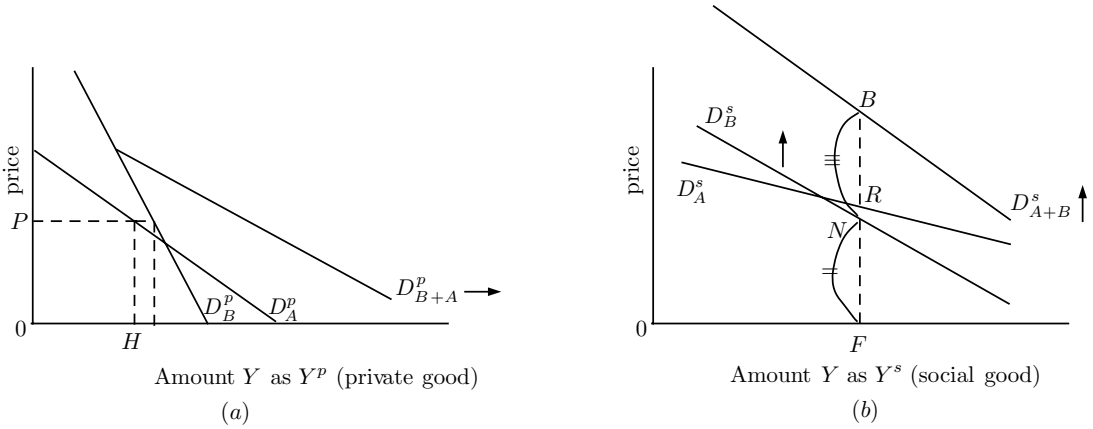


Figure 1: Non Substitute Externalities



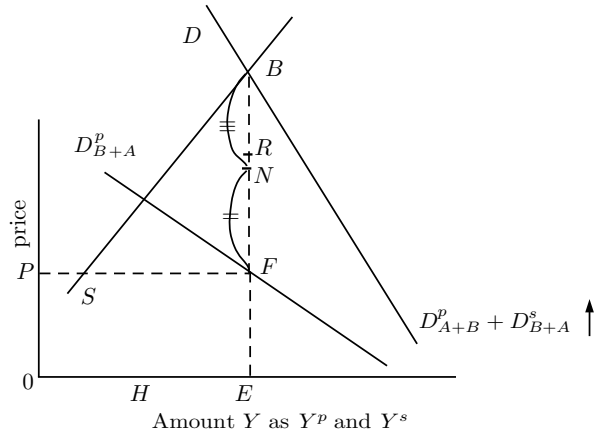


Figure 2: Mixed Benefit Goods

While much of the discussion between Musgrave and Samuelson[5] bears in fact on the proper definition of what a public good is, I am referring to it, here, because the analytics I just recalled include a feature not much stressed in the literature on public goods, namely that the good Y is produced by both A & B. That is, Musgrave is writing a model with *many producers* of the public good (or of the externalities). All of the literature until then, and most of it after, has always been dealing with economies with one producer only, or one single aggregate production function for the public good.

Where lies the interest of dealing with two (or more) producers of the public good instead of just one? Well, precisely where issues relating to cooperation are at stake.

Indeed, in that context, it is not only the (aggregate) amount of the public good that matters (for the determination of which preferences must be revealed in some appropriately cooperative way) but also the share taken by each producer in that production and, as a consequence, the amount of resources devoted to that by each unit. In addition, in an interpretation of A and B as regions with both consumers and producers, the possibility arises of transfers between regions that ought to be taken into account as they of course can play a role in the likelihood of cooperation.

3. How to achieve efficiency?

While efficient solutions were thus well defined for each one of the two cases, the Musgrave 1966 paper was not very explicit on the question of how these efficient solutions could be obtained. Just a "combination of a market mechanism and a tax-subsidy scheme" was called for by the author, but hardly elaborated upon.

An answer was to be offered to that kind of question in the late 60's and in the 70's by means of "resource allocation processes"[6] for public goods, formulated in terms of differential equations. In short, these were essentially

[5] With Sen's grain de sel, as he was the discussant of Musgrave's paper in Biarritz.

[6] In the terminology of Arrow and Hurwicz 1977. These were often called planning models (after Malinvaud 1970-71) or tâtonnement models (Drèze de la Vallée Poussin 1971). They find their origin in the Lange-Lerner theory of socialism.

mathematical algorithms allowing one to compute[7], in a tâtonnement-like sucession of steps, an efficient solution.

But these processes were rather poor from an institutional point of view. And institutions are of paramount importance[8] if one is to understand *how* an efficient, or an equilibrium state of the economy can emerge.

A richer interpretation of the model can therefore be offered if we consider it in the institutional framework of a federation. In this context, the issue at stake becomes the one of achieving efficiency for the federation, the members of which are *A* and *B*.

Several new and interesting problems arise when this view is adopted, and these are best revealed by thinking in the terms offered recently by Inman and Rubinfeld 1997a on federalism. These authors distinguish between three forms[9] of federalism:

(i) Planned[10] federalism
(ii) Cooperative federalism
(iii) Majority rule federalism.

By the very definition of federalism, all of these institutional forms share the common feature that a decentralized structure of government prevails for handling local issues. The way in which the three forms differ is by how the issues of common interest are resolved that require federal policies such as, *e.g.* handling of interregional externalities, supplying national or international public goods, making tax choices on geographically mobile bases, etc. Specifically, the above threefold distinction by the authors corresponds to procedures of:

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[7] An exercise effectively achieved for a real life international environmental externality (SO_2 emissions) in Kaitala, Mäler and Tulkens 1995 and further pursued in Germain, Toint and Tulkens 1995.
[8] As I argued in Tulkens 1978, section 4.
[9] Which they call "principles" of federalism.
[10] The authors call this "economic" federalism. (Apologies to the authors for substituting again my own words).

- technocratic planning conducted at the federal level, under institutional form *(i)*;
- unanimous agreement between representatives of each of the lower tier governments, under institutional form *(ii)* ;
- majority vote of elected representatives of the lower tier governments, under institutional form *(iii)* .

This taxonomy of alternative forms of federal coordination can readily be applied to the Musgravian models of interactions presented above (thinking, if relevant, in terms of more than just the two entities A and B ; both the models and the diagrams perfectly allow for that). It can of course be similarly applied to most other forms of interaction between federated entities.

What does it teach us about the outcome of cooperation in a federation?

If planning is understood in the old sovietic mode, its authoritarian character is contradictory with the idea of cooperation; it is thus of no interest to us. If instead planning is viewed in the sense of the resource allocation processes referred to above, it is essentially an information device. In particular, it identifies and computes the economic surplus that is generated along the path of efficiency gains. It also can compute various ways of sharing that surplus among the parties involved: fair ways, strategically stable ways, incentive compatible ways[11]... Planning in this democratic and "enlightened" sense should apparently solve completely the problem of achieving efficiency.

However, is such information sufficient for collective decisions to occur? Negotiations between the parties involved always follow their gathering of information. This is where the second Inman and Rubinfeld institutional form of federalism — cooperative federalism in their terms — comes in. The focus is on the negotiation process itself, seen as coasian bargaining. The authors' evaluation of it is a skeptical one, due to a number of difficulties: "inability of the parties to agree on how the surplus [...] should be divided", poor estimates of each other's threat point, concealment of information, complications of strategic interplay when the number of jurisdictions is large. "The overall record

[11] This takes unexpected forms in the case of sharing the surplus generated by a public input in a federal setting, as we discovered in Cattoir and Tulkens 2000

has not been impressive", they conclude, adding: "Our reading of the historical and contemporary evidence does not provide much support for the claim that lower-tier governments can solve their important collective action problems on their own through unanimous Coasian agreements" (p. 50).

Should this disappointing evaluation make us abandon the idea of cooperative federalism? I do not think so because we probably do not know enough as yet, in economics and public finance, about what fundamentally determines cooperation. Even between individuals the source of cooperation is poorly understood, as witnessed in a synthesis proposed recently by Elinor Ostrom 2000. Yet there are remarkable advances reported in that paper; they should provide inspiration for improvent in our our understanding of cooperation between jurisdictions.

That leaves us with the third institutional form: majority-rule federalism.

I shall not attempt to collect here the pros and cons of it, that Inman and Rubinfeld 1997a analyze in much detail and with subtlety. Let me simply record, on the one hand, that the equilibria yielded by majority voting at the federal level may not be efficient; and, on the other hand, that even when these equilibria are efficient, the majority vote always implies, by nature, a minority whose frustration may not be negligible.

Thus each one of the three institutional forms of federalism has its limitations, and none of them can pretend to guarantee full efficiency.

4. Non cooperative equilibria as "fall back" positions in federal affairs

After having noticed that cooperation has limitations, one is naturally led to ask: what is the outcome if cooperation does *not* take place? The federal framework suggests as an answer that each entity will then seek to implement, on the issues of common interest, the policies which are best for itself, given the policies chosen by the other entities in the federation.

This situation is nothing else than a non cooperative equilibrium between the entities in the sense of Nash 1951. It can be illustrated by means of

the Musgravian diagrams of 1966. In the case of Figure 1 diagrams, for instance[12], under no cooperation Region A chooses[13] OL^N and Region B, OG^N (see Figure 3).

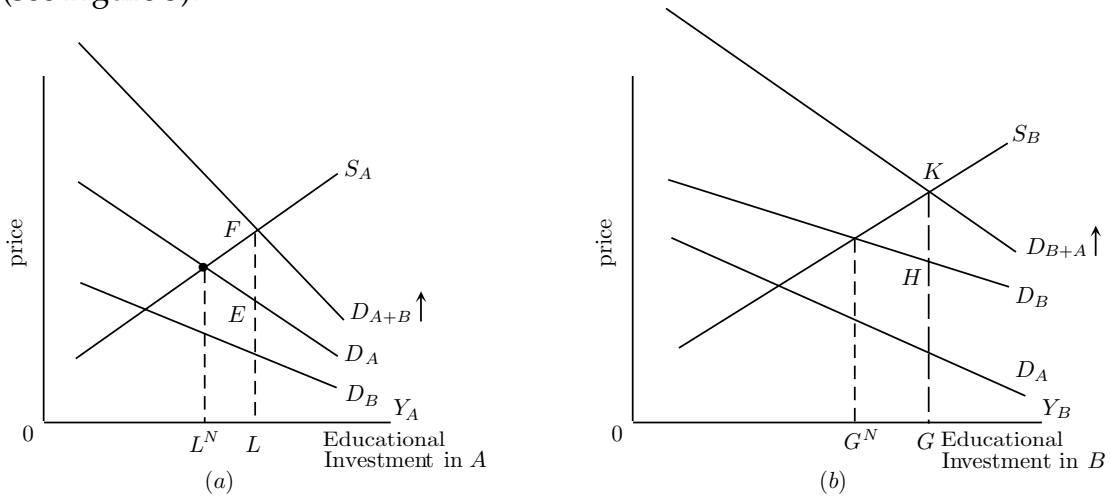

Figure 3: Non cooperative equilibrium between A and B for the case of "nonsubstitute externalities"

This well defined outcome, which of course generalizes to any number of regions, was not pointed out in Richard's paper because his interest was only in characterizing efficiency in the presence of externalities in general. But in the federal setting that I want to deal with presently, this particular situation is of considerable relevance and interest for several reasons.

First, it makes clear that a conceptual alternative can be conceived of to cooperation within the federation — and that this alternative is not necessarily chaos, or dismantling of the country, or disappearance of the public sector, or still some other catastrophical event — as hinted by some[14] in political debates. Instead, non cooperative fiscal equilibria are to be seen as reasonable "fall back positions" that will prevail in case cooperation cannot be achieved.

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[12] To handle case II, more should be specified concerning the supply curves.

[13] Strictly speaking, this is correct only under an assumption of separability in the preference functions of both A and B between the demands for Y_A and Y_B.

[14] This attitude is often oberved in young federations, and typically in Belgium, where at each step taken in the devolution process, litanies of fearful statements on the future of the country are recited even by otherwise competent intellectuals.

Notice that there is no reason to consider that a Nash equilibrium be of the nature of agressive threats that the parties would make against each other: the concept indeed rests on maximizing own regional benefit rather on maximizing harm to others.

Second, it follows from this first argument that non cooperative equilibria are worth studying for their own sake, so as to enable one to formulate relevant policy statements. In the literature of the last 15 - 20 years, much research and attention have been devoted to Nash equilibria between jurisdictions[15].

A most common trait of these works has been to emphasize the inefficiency feature of these equilibria; and on that basis many authors just dismissed the subject. But others have gone a few steps farther, for instance in attempting to answer all sorts of questions on the economic magnitudes involved: is public spending at such equilibria larger or smaller than at federally efficient levels? Are the taxes too high or too low? As a result directions of tax "reforms" are getting identified, in search for improvements on these equilibria.

A major example of non cooperative arrangements in federations is the phenomenon of tax competition. Within the European Union[16], this phenomenon plagues the correct levy of taxes on savings and on capital income, as everybody knows. The conceptual apparatus I am recalling here suggests that we are at present at a non cooperative equilibrium of some sort in this matter.

But I note from statements accompanying the reforms currently under preparation that a distinction is being made between "harmful" and "not harmful" fiscal competition. This amounts to recognize that not all fiscal competition equilibria are bad ones. Those which are not bad may not

[15] Bergstrom, Blume and Varian1986 provide an early and rich analysis of Nash equilibira in a model of voluntary provision of public goods. However, the actors involved in their model are individuals rather than juridictions. They are thus led to consider issues less directly relevant to federalism.

[16] Wich is not — yet — a federation, of course, but has many traits of it.

necessarily be efficient; but their degree of inefficiency may be small or innocuous.

This is why I would claim that better and more detailed knowledge of these equilibria and measurement of their distance from efficiency is desirable, for each category of taxes just as well as for expenditures with spillovers. That the early Musgrave diagrams were in fact offering a first step in that very direction is a conforting fact to engage us further in that task.

5. Searching for the Roots of Federalism

Let us now pursue the reasoning sketched out at the beginning of Section 4, with the further following question: if no cooperation is taking place and just a Nash equilibrium prevails between the members of the federation, what distinguishes this outcome from a confederation or even from a set of separate states?[17] In fact, the Musgrave diagrams, interpreted above in a federally decentralized context, apply equally well to two separate and independent states who interact with one another through the externalities generated by commodity Y.

Entertaining this kind of question should bring us in the area of constitutional law, for which I have no particular competence. Let me therefore remain within the domains of public finance, with its unmistakable support from economic theory.

Notice that on all my themes thus far on federalism, economics provides rich conceptual supports: externalities and public goods to describe interactions between entities[18]; efficiency and equity to specify objectives for cooperation;

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[17] This is pretty much a European question. Indeed, it is a characteristic of the U.S. economic literature on fiscal federalism that while authors pay much attention to how spending and taxing powers are devolved to higher or lower tiers of government, and seek for optimal or equilibrium degrees of decentralization, they hardly ever consider the question of the extreme degree of decentralization — that is, the breaking up of a federal state into separate states. A major excception is, of course, Inman and Rubinfeld 1997b to which I return below.

[18] And I should add the one of "reaction functions" if I had gone into more details on non cooperative equilibria.

non cooperative equilibria to illustrate decentralization; bargaining and voting models to formalize decision processes within the federation... Most of these concepts have been developed during the last half century. In short, one can say that public finance has thereby provided a lot to better understand the logic of federations and to derive from them improved levels of welfare.

Do public finance and economic theory provide similar conceptual tools to handle my question on decentralization beyond federalism?

To make my point sufficiently precise, let me remind us from constitutional law that, according to standard legal categories[19], a federation is a nation (or a State) whose existence results from a *constitution* adopted by its population as a result of some voting procedure. A confederation, to the contrary, is neither a nation nor a state; it owes its existence not to a constitution but to a *contract* — a treaty — unanimously signed by representatives of its member states and ratified by their respective domestic institutions.

Thus, decentralization beyond federalism amounts essentially to an abandonment of the constitutional link — while in the opposite direction, the creation of a federation, say in the European Union, implies writing and adopting a constitution.

For understanding what determines these steps — from constitution to contract, or from contract to constitution — I see no tool presently available in our discipline, well accepted and of sufficient generality.

There is however an important contribution in that direction. In section 2.3 of their 1997b extended survey on the political theory of federalism (companion to their 1997a article), Inman and Rubinfeld have formulated a model of constitutional choice based on benefits and costs of alternative institutional specifications of the federation as to *(i)* assignment of policy responsibility across levels of government and *(ii)* degree of representation of local interests within the central government. While the details of the model do account for essential components of the problem, the authors recognize that

[19] As reported, *e.g.* in Schmitt 1994.

their formulation does not lend itself, as yet, to conclusions of general nature. The proposed approach, though, is promising.

6. Conclusion

In the Musgravian world we can also find a hint towards answering the difficult question of the existence of a nation in spite of possible extreme decentralization. In his reply (Musgrave 1997) to the Inman and Rubinfeld paper in the *Journal of Economic Perspectives*, one finds a sentence that points in the following terms to the heart of the issue: "Ultimately, finding the appropriate jurisdiction [... has mainly to do ...] with the question, very much with us today, of how *closely-knit* a nation the member jurisdictions of the federation wish to form" (p.67, italics added).

It is not clear how the prevailing concepts of utility functions, private and public goods, equilibria and optima can accommodate the idea of a "closely-knit nation". Probably do we need to discover or construct other and new conceptual tools to master it. If someone could succeed in this task, public finance would bring about still another valuable contribution to the understanding and to the welfare of our nations.

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