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On the incentives to experiment in federations

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ON THE INCENTIVES TO EXPERIMENT IN FEDERATIONS

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ON THE INCENTIVES TO EXPERIMENT IN FEDERATIONS

Abstract

Conventional wisdom has it that policy innovation is better promoted in a federal rather than in a unitary system. Recent research, however, has provided theoretical evidence to the contrary: a multi-jurisdictional system is characterized - due to the existence of a horizontal information externality - by under-provision of policy innovation. This paper presents a simple model that introduces political competition for federal office. Under such competition political actors use the innovative policies in order to signal ability to the electorate. In the equilibrium analyzed policy innovation may occur more frequently than in a unitary system. It is thus shown that, once electoral motives are accounted for, the conventional wisdom is likely to be a valid proposition.

JEL Code: H77, R59.

Keywords: fiscal federalism, policy innovation, policy experimentation.

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1 Introduction

A commonly held view is that fiscal federalism promotes innovative public programs, speeds up the process of policy experimentation and its diffusion. This view has been recently expressed by the U.S federal government with regards to abatement technologies. The administration's chief climate negotiator, Harlan Watson, defended the U.S climate policy listing a variety of initiatives by states and communities. This 'bottom-up approach' is based on the fact that states are like 'laboratories where new and creative ideas and methods can be applied and shared with others and inform federal policy.'[1] This view is rooted in the argument that the division of the economy into a number of independent localities gives them the opportunity to experiment with policies. With several jurisdictions experimenting, the likelihood of finding the best policy is higher than if the control of the policy choice is left to the central government.[2] This view is most vividly summarized in the following citation by Justice Brandeis:

> 'It is one of the happy incidents of the federal system that a single courageous state may, if its citizens choose, serve as a laboratory and try novel social and economic experiments without risk to the rest of the country.'[3]

While this statement has received widespread support, recent theoretical analysis suggests the contrary: a decentralized system is conducive to producing fewer policy innovations than a centralized one. This might be, for instance, the case either because of political risk—as in Rose-Ackerman (1980)—or because of a horizontal information externality, as in Strumpf (2002). This latter contribution considers a model in which local policymakers decide on policy experiments the outcomes of which are correlated across states. This correlation creates a learning externality and therefore an incentive

[1]Herald Tribune, December 11, 2003, p.1, 'Warming feud: states vs. Bush team', by A. Revkin and J. Lee. For further examples of innovative policies, see Strumpf (2002).

[2]See, for instance, the insightful survey of Oates (1999), but also Inman and Rubinfeld (1997), Kollman *et al.* (2000), and Besley (2001). For an early empirical analysis of the diffusion of innovations among the U.S states see Walker (1969). For a recent study at the local level, see Rincke (2005).

[3]Brandeis, J. *dissenting*, New State Ice Co. v. Liebmann, 285 U.S. 262, 311 (1932).

for the policymakers to free-ride on each other's innovative efforts. This incentive to free ride leads, typically, to under-experimentation relative to the social optimum that could be generated by a unitary government.[4]

An important aspect that is insightfully discussed but not formally investigated by Rose-Ackerman (1980) and Strumpf (2002, section 4.3) concerns the federal political institutions and, more importantly, the electoral incentives faced by the state policymakers in a federal system. It is quite common observation that in federal systems regional governors run for federal office. Consider, for instance, the U.S experience: with the exception of George Bush senior all of America's past five presidents previously have been governors. The same is true, to give another example, for Germany where four out of the last five chancellors were ex-premiers of federal states. Though this does not show the innovativeness of the governors prior to the federal elections, it does show their level of political aspirations. Arguably, the implementation of new and unknown policies is more demanding than running 'business as usual' since it requires imaginative leadership on the part of a governor, rather than operational routine. One, therefore, would expect that in federal contests, being innovative at the state level, may positively influence the voters' perception of the ability of a governor standing for federal office.[5] This is, then, the objective of this paper: to incorporate federal elections into an analysis of policy experimentation by local jurisdictions.

In the model presented in Section 2, two state governors, each of whom can be of different ability, choose between several experimental policies and a policy with a certain outcome. After the policy has been implemented, both governors run for the federal presidency and the winner of the elections chooses a federation-wide policy. In

[4]This conflict (and the need for more research on this topic) between the conventional wisdom and the conclusions arrived at by the contributions of Rose-Ackerman (1980) and Strumpf (2002) is also emphasized in Oates (1999). Besley (2001) stresses the lack of understanding of the interaction of political institutions and policy experimentation.

[5]This view is shared by political observers too. In a commentary, for example, J. Podhoretz notes, '...although he is not a bold politician, Bush is an innovator. On all these issues [education, social security and medicare] he has fresh proposals that derive from state and local politics – from **experiments** by the Republican governors like himself who have come to dominate the 50 state capitals.' *The Times*, October 13, 2000. Commentary: 'Gore has made his bed, but nobody wants to lie in it.' Bold face emphasis added.

this framework a learning externality, arising from correlation of policy outcomes across states, exists. This creates incentives for each governor to avoid the cost of experimentation and, if elected president, to make use of the information procured in the other state. This incentive, however, is mitigated by two effects: the signaling and the policy effect. The former effect, and to some extent the most obvious, refers to the incentive of a governor to signal ability to the electorate by experimenting. The policy effect refers to the nature of the federal political career: a governor anticipating to become president and then to govern the entire nation will take into account the benefit procured to the other state by her own choice of policy experimentation. It is the combination, and strength, of these two effects that makes governors opt for the experimenting public policy.

The outcome of this federal setup is compared with a benchmark of a unitary nation where a president is responsible for the entire federation. For the unitary case, we distinguish between a non-democratic benchmark without election, and a nationwide election where the incumbent president has to face a challenger from the opposition. It is shown that the federal system is more innovative than both benchmarks provided the signalling and policy effects are stronger than the learning externality.

The simple framework analyzed is rich in implications. It is shown that, strikingly, the possibility that a federal system is more conducive to policy experimentation than a unitary system, once the political process for federal office is accounted for, is a real one. This conclusion validates the conventional wisdom that has been vividly expressed in the quotation by Justice Brandeis.[6]

The paper is organized as follows. Section 2 describes the model. Section 3 analyzes the equilibrium of the model, and Section 4 compares it to the unitary outcome without election. In Section 5 the model is varied to allow for an election in the unitary system. Finally, Section 6 concludes.

[6]This conclusion, though derived in an entirely different context, is reminiscent of the idea that the existence of a federal government may over-turn the (negative) inefficiencies arising from non-cooperative behavior at the state level, Keen and Kotsogiannis (2002).

2 The model

We study a dynamic two period model which incorporates signaling and an election between both periods.[7] We abstract, for simplicity, from discounting between the two periods. There are two states that are identical in all respects. In period 1 in each state a governor is in charge of choosing policy. In the end of that period both governors run for the federal presidency. In period 2 the president selects policy for both states.[8]

Policymakers are of two abilities: high, denoted by $\overline{\alpha}$, and low, denoted by $\underline{\alpha}$, with, in particular, $\overline{\alpha} > \underline{\alpha} > 0$. Ability is private information. Each policymaker is of high ability with probability $\lambda \in (0, 1)$. The abilities of the two governors are independent of each other.

In both periods incumbents decide whether to introduce one out of m new and innovative public policies where m is a large number. The returns of these policies are probabilistic and depend on the policymaker's ability. In particular, exactly one of the new policies has a high quality,[9] denoted by $q_h + \alpha$, while the other $m - 1$ new policies are of low quality, denoted by $q_l + \alpha$, where $\alpha = \overline{\alpha}, \underline{\alpha}$ and $q_l > 0$.[10] Thus, if there is an experiment with one new policy, it is of high quality with probability $\theta \equiv 1/m$. Alternatively, the policy makers may use a public policy whose return is certain and given by q_o. This policy can have a dual interpretation: it can be either an old one that has been used in the past or a new policy with a certain return. The policies are ranked according to

$$q_h + \overline{\alpha} > q_h + \underline{\alpha} > q_o > q_l + \overline{\alpha} > q_l + \underline{\alpha}\,. \tag{1}$$

This assumption says that the difference in the qualities of the policies $q_h - q_l$ is larger

[7] A variant of this model in the context of a single jurisdiction can be found in Kotsogiannis and Schwager (forthcoming).

[8] The issue at the heart of the paper is to compare the incentives of governors for experimentation arising within a given federal election. Two states are sufficient for this purpose. We also abstract from incentive considerations arising from the re-election of the president of the federation after period 2.

[9] Policies are costly and, without loss of generality, their cost has been suppressed.

[10] Combining ability and random policy outcome in an additive specification is a convenient way to describe the main effects while keeping the notational burden to a minimum.

than the difference in abilities $\overline{\alpha}$, $\underline{\alpha}$. Central to this paper are the incentives of the policymakers to experiment and so it is imperative to restrict attention to a policy innovation which is not from the outset superior to the old policy. We, therefore, assume that

$$\theta \leq \frac{q_o - (q_l + \overline{\alpha})}{q_h - q_l} \equiv \theta^* \,. \tag{2}$$

This restriction simply says that the innovative policy does not provide a short run benefit to a governor.[11] It is then clear, following from (2), that any incentive to innovate arises from the dynamic nature of the model. We turn to this next.

During the first period, citizens observe the quality q_i ($q_i = q_h + \overline{\alpha}, q_h + \underline{\alpha}, q_o, q_l + \overline{\alpha}, q_l + \underline{\alpha}$) of the policy in both states and form beliefs about the ability of both governors. The posterior probability that the governor of state i is of high ability given the quality q_i of the policy is denoted by $\mu_i(q_i)$. At the end of the first period there is an election. Voting is retrospective and citizens elect for president the governor who is more likely to be of high ability. That is, if $\mu_i > \mu_j, i = 1, 2, i \neq j$, then citizens elect for president the governor of state i. In case $\mu_i = \mu_j$ they toss a coin and each governor is elected with probability 1/2.

The outcome of a specific experimenting policy is perfectly correlated across states. This implies that, once a certain new policy is chosen in state i its quality becomes common knowledge also in state j.[12] Consequently, if a successful experiment was performed in the sense that an innovative policy turned out to be of high quality, whoever is in charge of the policy decision in period 2, can use this information in both states. The sequence of events is illustrated in figure 1.

Policymakers derive utility from the per-period quality of the policy chosen provided they are in office. In period 2 the governor who is not elected president receives zero utility. Specifically, this implies that being ousted from office confers lower utility than any policy outcome.

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[11] Though the restriction in inequality (2) refers to the high ability governor it, too, holds, following from $\overline{\alpha} > \underline{\alpha}$, for the low ability one.

[12] This is for simplicity. Imperfect correlation across states is feasible but it obscures the main forces at work.

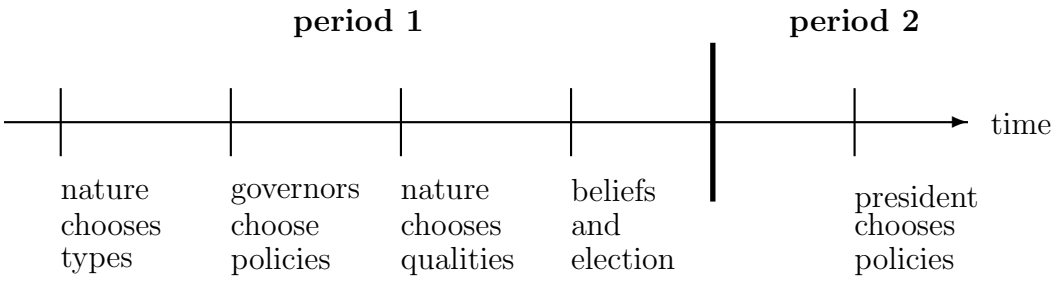

Figure 1: The sequence of events.

This model defines a game between both types of the policymakers in both states. At the beginning of the game Nature chooses the ability type of both governors. A strategy for each type of governor in state $i = 1, 2$ consists, first, of a policy decision for state i in the first period. The second component is a rule, possibly depending on the policy outcomes observed in period 1, that specifies the policy choices for both states in period 2, should the governor of state i be elected as president. An equilibrium of this game consists of a strategy for each ability type of the governor of each state and of citizens' beliefs satisfying two requirements. Firstly, given the beliefs of the citizens and the strategies of both types of governor in state $j \neq i$, the strategy of the governor of state i has to be optimal whenever this governor is called upon to decide. Secondly, the beliefs must be consistent with the governors' strategies.

3 The federal system

We start by analyzing the president's choices in the second period after the first period election. In the second period the president has no re-election motives and thus chooses the policy which yields the highest expected quality. First, there may have been an experiment in the first period which has proved successful. If this is the case, the president is informed that this new policy is of high quality. Consequently, she then chooses this new policy in both states yielding a payoff $2(q_h+\alpha)$ where α is the president's ability. If one or both governors tried out new policies but each of these policies showed to be of low quality, the president, following (2), returns to the old policy obtaining

the payoff $2q_o$.[13] The same decision is optimal if no state has experimented with a new policy.

As noted in the introductory section, the purpose of this analysis is to show the possibility that a federal system produces over-experimentation relative to a unitary state. We do so by picking an equilibrium which is indeed characterized by more innovation relative to a unitary state.[14] In this equilibrium in both states the low ability governor selects the old policy. The high ability governors in both states experiment, each one choosing a different new policy. This leads to beliefs $\mu_i(q_h + \overline{\alpha}) = \mu_i(q_l + \overline{\alpha}) = 1$ and $\mu_i(q_h + \underline{\alpha}) = \mu_i(q_l + \underline{\alpha}) = \mu_i(q_o) = 0$ for $i = 1, 2$.

Consider now, given these beliefs, the choices open to a high ability governor in state i assuming that the governor of state $j \neq i$ behaves according to the hypothesized strategies. If the governor of state i chooses a new policy her expected first period payoff is given by

$$\theta\left(q_h + \overline{\alpha}\right) + (1 - \theta)\left(q_l + \overline{\alpha}\right) . \tag{3}$$

By this choice, she reveals her high ability to the electorate ensuring a belief $\mu_i = 1$. If the governor of state j is of high ability, her strategy being the same, she also reveals her type implying $\mu_j = 1$. In this case the governor of state i wins the election with probability $1/2$. Since there were two different experiments, the probability of knowing a high quality new policy in the second period is 2θ, while with probability $1 - 2\theta$, both experiments failed. Conditional upon winning the election against a high ability competitor from the other state the expected second period payoff of the governor of state i is thus

$$2\left[2\theta\left(q_h + \overline{\alpha}\right) + (1 - 2\theta)\, q_o\right] . \tag{4}$$

If, now, the governor of state j is of low ability she chooses the old policy which leads to

[13] Since a new policy chosen in the first period has been eliminated from the pool of new policies, the probability of finding a high quality new policy in the second period will be updated. An updated version of (2) then holds if m is sufficiently large. This allows us not to worry about the precise values of the updated probabilities in every eventuality.

[14] A full characterization of the equilibria of the model can be provided. This, however, will not provide any further insights into the effects leading to innovation in a federal system. For the sake of brevity these equilibria are therefore omitted.

$\mu_j = 0$ ensuring that the governor of state i is elected with probability 1. Since now the governor of state i is the only one who tried out a new policy, the probability of knowing a high quality new policy is just θ. Thus, if the governor of state j is of low ability, the second period payoff of the governor of state i is

$$2\left[\theta\left(q_h + \overline{\alpha}\right) + \left(1-\theta\right)q_o\right]\,. \tag{5}$$

To obtain the expected second period payoff of the governor of state i we first multiply (4) with the prior probability λ for the event that the governor of state j is of the high ability type, and with the probability $1/2$ of winning the election against this competitor. Then, we similarly multiply (5) with λ and 1, and add the results. Adding the expected second period payoff to (3) finally yields the total payoff from choosing a new policy

$$\overline{v}_g(n) \equiv \theta\left(q_h + \overline{\alpha}\right) + \left(1-\theta\right)\left(q_l + \overline{\alpha}\right) + 2\theta\left(q_h + \overline{\alpha}\right) + (1-2\theta)q_o + (1-\lambda)q_o\,. \tag{6}$$

In principle, the governor of state i could as well choose the same new policy as the governor of state j. With such a choice, in the payoff in (4), the probability 2θ for knowing a good new policy in period 2 would have to be replaced by θ, while the remaining components of the payoff would not change. Thus, choosing the same innovation as the other governor is never preferred to choosing a different innovation.

If the governor of state i chooses the old policy the first period payoff is q_o. Having chosen the old policy the governor of state i is taken to be, following $\mu_i(q_o) = 0$, of low ability. If the governor of state j is of high ability, this happens with probability λ, the governor of state i is defeated in the elections obtaining zero second period payoff. With probability $1-\lambda$ the governor of state j is of low ability implying $\mu_j = 0$. In this case the governor of state i is elected with probability $1/2$. Since no experiment has taken place, the second period payoff for the governor of state i in this case is $2q_o$. The total payoff from choosing the old policy, then, is

$$\overline{v}_g(o) \equiv \left(2-\lambda\right)q_o\,. \tag{7}$$

Comparing equations (6) and (7) it is immediate, following from $q_h + \overline{\alpha} > q_o$, that

$\overline{v}_g(n) > \overline{v}_g(o)$. It is thus optimal for the high ability governor of state i to choose a new policy.

We now turn to the low ability type governor in state i. If this governor chooses the old policy then in the first period her payoff is q_o. In this case she is defeated in the election if the governor of state j is of high ability and she is elected with probability $1/2$ if the governor of state j is also of low ability. In the latter case the second period payoff, conditional on winning the election, is given by $2q_o$. Consequently, the total payoff from choosing the old policy for the low ability type, denoted by $\underline{v}_g(o)$, is given by (7).

If the low ability governor chooses the new policy in the first period then the first period benefit is given by (3) with $\overline{\alpha}$ replaced by $\underline{\alpha}$. In this case she is elected with probability $1/2\,(1-\lambda)$. Since there was one experiment in this case the expected payoff in the second period, conditional on being elected, is then given by $2\left[\theta\left(q_h+\underline{\alpha}\right)+(1-\theta)\,q_o\right]$. Combining first and second period payoffs one obtains

$$\underline{v}_g(n) \equiv \theta\left(q_h+\underline{\alpha}\right)+(1-\theta)\left(q_l+\underline{\alpha}\right)+(1-\lambda)\left[\theta\left(q_h+\underline{\alpha}\right)+(1-\theta)\,q_o\right]. \tag{8}$$

Comparison between equations (7) and (8) reveals that $\underline{v}_g(o) \geq \underline{v}_g(n)$ if

$$\theta \leq \frac{q_o-\left(q_l+\underline{\alpha}\right)}{\left(q_h-q_l\right)+(1-\lambda)\left(q_h+\underline{\alpha}-q_o\right)} \equiv \underline{\theta}_g\,. \tag{9}$$

That is, the low ability governor of state i chooses the old policy if $\theta \leq \underline{\theta}_g$. Close inspection of the definition in (9) reveals that $\underline{\theta}_g$ is positive and that it is below θ^* as defined in equality (2) if $\underline{\alpha}$ is not too far below $\overline{\alpha}$. Restricting attention to this case, we arrive at:

Proposition 1 *For all $\theta \in [0, \underline{\theta}_g]$ there exists an equilibrium where in both states the high ability governor experiments and the low ability governor selects the old policy.*

We turn now to the benchmark case in which policies are chosen by the president of the unitary nation.

4 The unitary nation

The president of the unitary nation in the first period chooses the policy for each state. There are four choices open to her: choose two different new policies in both states; choose the same new policy in both states; choose a new policy in one and the old policy in the other state; and choose the old policy in both states.

Consider the high ability type and the first of these options. Choosing different new policies in both states in the first period she obtains payoff, in each state, given by (3). In the second period, having experimented twice in the first, she obtains a payoff given by (4). Adding these payoffs one obtains

$$\overline{v}_p(nn) \equiv 2\left[\theta(q_h+\overline{\alpha})+(1-\theta)(q_l+\overline{\alpha})\right]+2\left[2\theta(q_h+\overline{\alpha})+(1-2\theta)q_o\right]. \tag{10}$$

The second possible choice, consisting of the same new policy in both states gives the same first period payoff. In the second period, the payoff $q_h+\overline{\alpha}$ is obtained only with probability θ instead of 2θ. Therefore, this strategy is clearly dominated by the previous choice. If now she chooses the new policy in one state and the old in the other, in the first period she obtains payoff $\theta\left(q_h+\overline{\alpha}\right)+(1-\theta)\left(q_l+\overline{\alpha}\right)+q_o$. In the second period, after one experiment she knows a successful new policy with probability θ, and thus receives the payoff given by (5). Total payoff from this choice, then, is

$$\overline{v}_p(on)=\overline{v}_p(no)\equiv\theta\left(q_h+\overline{\alpha}\right)+(1-\theta)\left(q_l+\overline{\alpha}\right)+q_o+2\left[\theta\left(q_h+\overline{\alpha}\right)+(1-\theta)\,q_o\right]. \tag{11}$$

Finally, if she chooses the old policy in both states she obtains a total payoff of

$$\overline{v}_p(oo)\equiv 4q_o\,. \tag{12}$$

Comparing the payoffs arising from these three choices we first observe from equations (10) and (11) that $\overline{v}_p(nn)\geq\overline{v}_p(on)$ if

$$\theta\geq\frac{q_o-(q_l+\overline{\alpha})}{(q_h-q_l)+2\left(q_h+\overline{\alpha}-q_o\right)}\equiv\overline{\theta}_p\,. \tag{13}$$

A comparison now of equations (11) and (12) reveals that $\overline{v}_p(on)\geq\overline{v}_p(oo)$ if the same inequality $\theta\geq\overline{\theta}_p$ is satisfied. Conversely, if the reverse inequality holds in (13), then $\overline{v}_p(oo)\geq\overline{v}_p(on)\geq\overline{v}_p(nn)$.

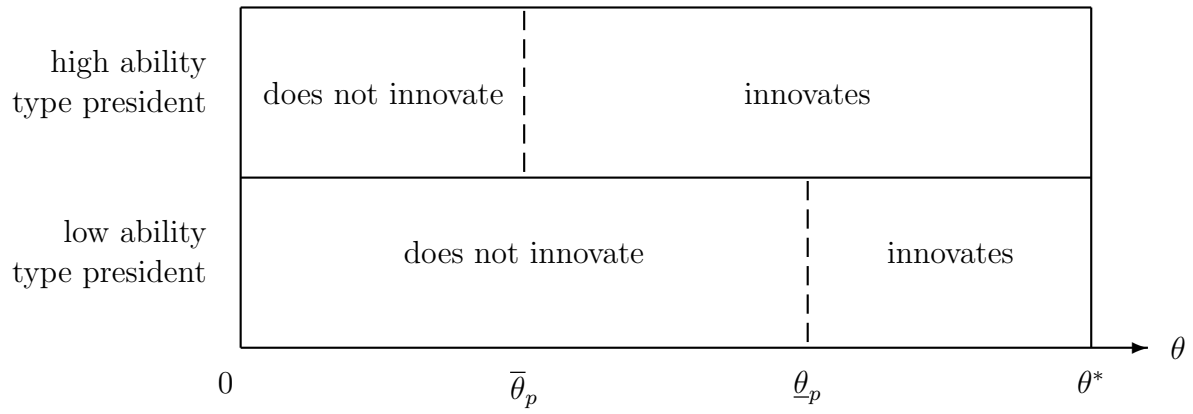

Figure 2: The optimal choice of the president of a unitary nation.

Similarly, following analogous reasoning, the low ability president chooses to experiment in both states state if $\theta \geq \underline{\theta}_p$, where $\underline{\theta}_p$ is defined as $\overline{\theta}_p$ in (13) but with $\overline{\alpha}$ replaced by $\underline{\alpha}$. If $\theta \leq \underline{\theta}_p$, it is optimal for this type not to innovate at all. It is easy to verify, following $\overline{\alpha} > \underline{\alpha}$, that $\underline{\theta}_p > \overline{\theta}_p$. Moreover, both $\overline{\theta}_p$, $\underline{\theta}_p$ are positive. Finally, $\overline{\theta}_p$ is strictly less than θ^*, which is also true for $\underline{\theta}_p$ provided that $\underline{\alpha}$ is not too low. We so have:

Proposition 2 *(i) For all $\theta \in [0, \overline{\theta}_p]$, it is optimal for both types of the president of the unitary nation to choose the old policy in both states.*

(ii) For all $\theta \in [\overline{\theta}_p, \underline{\theta}_p]$, it is optimal for the high ability type president of the unitary nation to choose two different new policies in both states. For the low ability type it is optimal to choose the old policy in both states.

(iii) For all $\theta \in [\underline{\theta}_p, \theta^*]$, it is optimal for both types of president of the unitary nation to choose new policies in both states.

Proposition 2 is illustrated in figure 2.

In order to compare the outcome in the federal system of Proposition 1 with that of the unitary system of Proposition 2 we now need to relate the critical values $\underline{\theta}_g$ and $\underline{\theta}_p$. A simple comparison between (9) and (13) (with $\overline{\alpha}$ replaced by $\underline{\alpha}$) shows that $\underline{\theta}_p < \underline{\theta}_g$. Consequently, the interval $[\overline{\theta}_p, \underline{\theta}_p]$ is contained in $[0, \underline{\theta}_g]$.

To progress further in the comparison, we now define a measure of innovation. A

natural measure in the present context is the expected number of new policies chosen in the first period. In the equilibrium described in Proposition 1 three cases can arise. If there is a high ability type governor in both states, which happens with probability λ^2, a new policy is chosen in each state. With probability $2\lambda(1-\lambda)$ there is a high ability type governor choosing a new policy in one state only. Finally, with probability $(1-\lambda)^2$ both governors are of low ability type producing no innovation. Altogether the expected amount of innovation is $2\lambda^2 + 2\lambda(1-\lambda) = 2\lambda$.

Turning now to the choice of the president of the unitary nation, as given in Proposition 2, we observe that for $\theta < \overline{\theta}_p$ there is no innovation. For $\theta \in [\overline{\theta}_p, \underline{\theta}_p]$ the president chooses a new policy in both states if she is of high ability but none if she is of low ability. In this case the amount of innovation is 2λ. Finally, for $\theta \in [\underline{\theta}_p, \theta^*]$, whatever the type of the president, she chooses new policies in both states. The amount of innovation is, then, 2. Summarizing:

Proposition 3 *In a federal system the expected number of innovations is larger than in the unitary nation for all $\theta \in [0, \overline{\theta}_p)$. For all $[\overline{\theta}_p, \underline{\theta}_p]$, the federal and the unitary systems produce the same expected number of innovations. For all $\theta \in (\underline{\theta}_p, \underline{\theta}_g]$ the federal system produces less innovation than the unitary nation.*

The trade-off leading to the optimal decision of the president of the unitary nation, as stated in Proposition 2, is rather intuitive. On the one hand, innovation is costly because in expected terms a new policy fares worse than the old policy in period 1. On the other hand, the information produced in period 1 by experimenting allows for a higher payoff in the second period. Therefore, if θ is not too low, as in case *(ii)* of Proposition 2 for the high ability type, and in case *(iii)* for both types, the learning benefit outweighs the short term cost of innovation. Hence, the president of the unitary nation finds it optimal to innovate.[15] If, conversely, θ is too low, then no innovation takes place in the unitary nation.

[15]In our simple formulation, the marginal learning benefit of an additional innovation does not decrease. Therefore, a corner solution arises where innovation occurs either in all states or not at all.

In the federal system the same trade-off exists because the governors, too, have an incentive to learn. The difference between the two systems arises from two considerations introduced by electoral competition. Firstly, with the probability for each governor of winning the election being less than one, the benefit of learning is not fully internalized. Secondly, the high ability governor enhances her electoral prospects by innovating, thereby communicating her ability to voters. For this type, the electoral benefit always outweighs the costs of innovation. To see this clearly, consider the extreme case where the new policy is of low quality with certainty, that is, $\theta = 0$. Switching from the new to the old policy confers a first period gain of q_o but in the same time reduces the probability of winning the election by 1/2. Since the second period payoff, conditional on being elected president, is $2q_o$, deviating to the old policy does not pay off. Thus, the high ability governor innovates even if there is no benefit from learning. Obviously, in the case where both governors are of high ability both have the same electoral motives to innovate. Consequently, in this case, there may be double innovation in the federal system even if the learning benefit is negligible.

A low ability governor prefers not to reveal her ability to the voters and hence she has no electoral motive for choosing the new policy. As a consequence, her decision is entirely determined by the trade-off faced also by the president of the unitary nation: the trade-off, that is, between the short term costs of innovation and the benefit of learning. Because of the information externality, $\underline{\theta}_g$, the minimum value for θ such that she innovates, is higher than $\underline{\theta}_p$, the minimum value of θ required to induce the low ability type of the president of the unitary nation to innovate. For this reason, if θ is between these values, the federal system produces less innovation than the unitary nation. The comparison described in Proposition 3 is illustrated in figure 3.

5 Opposition candidates

In the present section, we change the model such that also the president has to stand for re-election. Lacking any competing incumbent from a different state, however, a

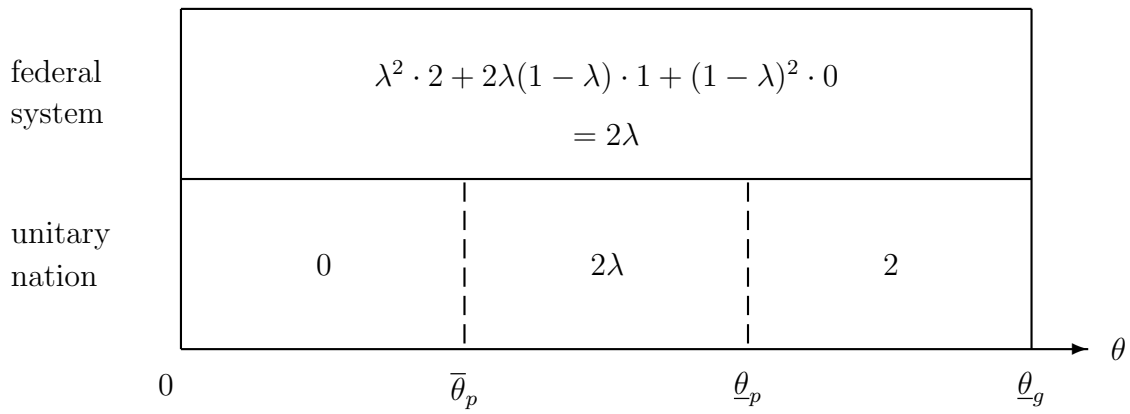

Figure 3: The innovation score.

challenger in such an election has to be an opposition politician who does not currently hold any office. Since this politician does not take any policy decision, citizens will believe that she is of high ability with the prior probability λ. In order to keep the institutional setups comparable, we introduce a third contender, whose belief is given by the prior λ, also in the election in the federal system. Finally, the behavior of the voters is essentially the same as before. Specifically, citizens elect the candidate to whom they assign the highest belief of being of high ability. If there are several such candidates, the votes will be split among them.

For the federal system, we again consider an equilibrium where high ability governors choose different new policies while low ability governors stick to the old policy. This implies the same beliefs as in the equilibrium analyzed in Section 3. A governor who has chosen a new policy reveals her type, and any governor who chooses the old policy is taken to be of low ability. Thus, in such an equilibrium, a high ability governor who innovates still beats a low ability type governor with certainty. Moreover, she also beats the challenger since the voters assign only belief $\lambda < 1$ to this unknown contender. Finally, if the other governor is also of high ability, the two governors are preferred to the challenger and elected with probability $1/2$ each. Thus, for a high ability governor, the payoff from choosing a new policy remains $\overline{v}_g(n)$ as given in (6).

Contrary to this, if the governor chooses the old policy, her election chances are

affected by the presence of the challenger. The reason is that the citizens prefer the challenger, who may be of high ability with positive probability, to any candidate whom they believe to be of low ability with certainty. By consequence, choosing the old policy results in a sure defeat, yielding a total payoff of q_o. Since this is lower than the corresponding payoff $\overline{v}_g(o)$ given in (7) in the model without opposition candidate, a governor of the high ability type will still choose to innovate for all θ.

By the same reasoning, the presence of the challenger makes it impossible for a low ability type governor to win the election. Whether she chooses the new or the old policy, citizens will always assign belief 0 to her and elect either the other governor or the challenger. As a consequence, the second period payoff of a low ability type governor is zero. This however, following on (2), eliminates any incentive to choose a new policy in the first period. To summarize, we note that the hypothesized equilibrium exists for all $\theta \in [0, \theta^*]$.

In the unitary system, we now have a game between the presidents of both types, where in an equilibrium, citizens form beliefs consistent with the strategies of both types. We consider equilibria such that a low ability type president chooses the old policy in both states whereas a high ability president innovates at least once. With these strategies, citizens will attach a belief of 0 to a president who chooses the old policy in both states.

Just like a low ability type governor, a low ability type president facing a challenger with belief λ will certainly lose the election. Since the old policy provides a higher payoff in the first period, it will therefore be chosen by the low type president in both states. The high ability type president will be considered to be of the low ability type if she chooses the old policy in both states. Thus, after this first period choice she will lose the election against the challenger, implying a total payoff of $2q_o$. If instead she chooses a new policy in one state and the old policy in the other state, her high ability will be known to the electorate, ensuring a re-election with probability 1. Given that there was just one experiment in the first period, this yields an overall payoff $\overline{v}_p(on)$ as given in (11). This clearly exceeds $2q_o$, implying that it is not optimal for the high ability president to choose the old policy in both states. Finally, choosing two different innovations in

the two states, the president again is re-elected with certainty. Taking into account the fact that now there were two experiments, the total payoff in this case is $\overline{v}_p(nn)$ as in (10). From the analysis in Section 4 we know already that $\overline{v}_p(nn) \geq \overline{v}_p(on)$ if and only if $\theta \geq \overline{\theta}_p$. Hence, we have an equilibrium where the high ability type president chooses one innovation for $\theta \leq \overline{\theta}_p$, and we have an equilibrium where she experiments twice if $\theta \geq \overline{\theta}_p$.

Comparing the innovation scores in both setups, we notice that in the federal system, the expected number of new policies in the first period is now 2λ for all $\theta \in [0, \theta^*]$. In the unitary system, this number is λ if $\theta \in [0, \overline{\theta}_p)$ and 2λ for $\theta \in (\overline{\theta}_p, \theta^*]$. Summarizing:

Proposition 4 *If an opposition politician runs against the president and the governors, then the expected number of innovations is higher in a federal system than in a unitary one if* $\theta \in [0, \overline{\theta}_p)$. *Both systems produce the same expected number of innovations if* $\theta \in (\overline{\theta}_p, \theta^*]$.

Proposition 4 is illustrated in figure 4. A comparison of figures 3 and 4 shows how the incentives of the president of a unitary nation change if she has to stand in an election. For the high ability type, it now pays off to signal ability to voters, as it does for a high ability type governor. However, since there is only one president, one single innovation is sufficient to achieve this. This contrasts with the federal system where every high ability type governor wants to produce the signal. Therefore, for low values of θ, the federal system is still more innovative than the unitary system with elections, although the difference is smaller than in the case, studied in Proposition 3, without election in the unitary state. For the low ability type president, the contest with the challenger has the opposite effect. This type never innovates if she is subject to an election since she is ejected with certainty, and thus has no incentive at all to learn. When electoral competition is introduced, politicians with good prospects in the election invest more in winning, and so are more inclined to experiment. In the same time, those who expect to lose reduce their effort of finding solutions, the benefit of which will occur only after the end of their own term, and so decrease innovative activity. The first effect, however, is

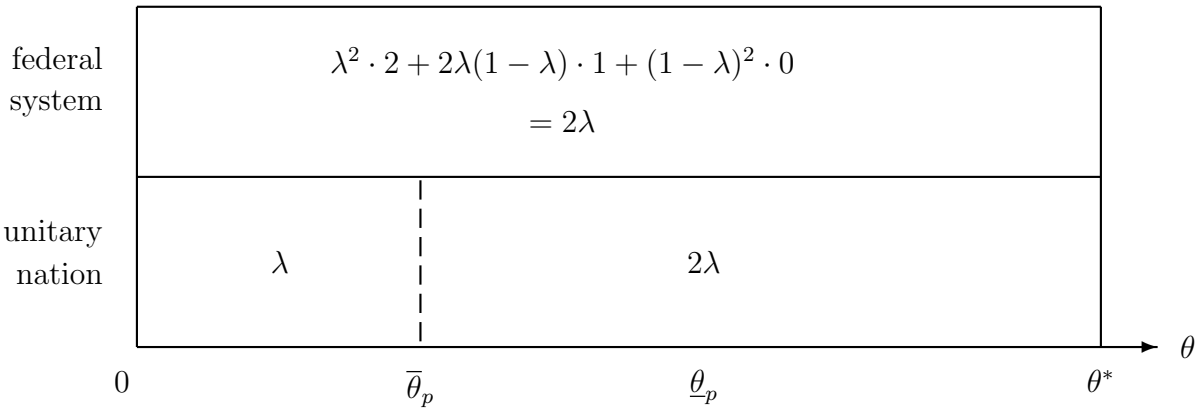

Figure 4: The innovation score with opposition candidates.

stronger in the federal system since all governors are potentially hopeful contenders for the presidency.

6 Concluding remarks

Conventional wisdom has it that federalism promotes policy innovation. In contrast, recent research has emphasized that a multi-jurisdictional system is characterized by under-provision of policy innovation. The present paper has presented a simple model introducing political competition into the analysis of a federal system. In the equilibrium analyzed, a tradeoff occurs between a learning incentive which is indeed stronger in a unitary system, and an electoral motive to signal ability by innovating which is stronger in the federal system. Thus, when the electoral motive dominates, policy innovation occurs more frequently than in a unitary nation. This shows that once such motives are accounted for, the conventional wisdom is validated.

To put this result into perspective, the analysis has been purely positive and not normative. It remains an open question whether the tendency to innovate in a federation is beneficial to citizens. To progress on this issue one would need to carefully specify the appropriate benchmark and, in particular, define, independently from the institutional setup, the set of policy makers from which the president in period 2 can be chosen.

The model suggests a number of extensions. Firstly, learning across states and

between periods may be less than perfect. Secondly, the signal about the governor's ability conveyed by innovating may not be fully informative. Finally, another avenue for research is to incorporate other forms of political competition in federal systems. Certainly, there remains much scope for the analysis of experimentation in richer models of political competition. We hope to have shown that the task is worthwhile and that the conclusions can be instructive.

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