

Schneider, Andrea

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Policy diffusion and the competition for mobile resources

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Policy Diffusion and the Competition for Mobile Resources*

Andrea Schneider[†]
University of Münster & NoCeT

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Abstract

This paper analyzes competition for mobile resources when a region can adopt a policy that has previously been implemented by another region. In equilibrium, the region with an initially low-quality reform adopts the high-quality reform. Since policies in different regions converge and agents are forward-looking, the model provides an explanation for low-response elasticities. Finally, the paper analyzes the effects of an increase in mobility on the quantity and quality of reforms.

JEL classification: D78; F23; H77

Keywords: policy diffusion; mobile resources; interregional competition

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[†]Corresponding author: Andrea Schneider, University of Münster, Institute of Public Economics, Wilmergasse 6-8, 48143 Münster, Phone +49-251-83-22871, Fax +49-251-83-22826, Email andrea.schneider@uni-muenster.de.

1 Introduction

The objective of this paper is to explain policy diffusion with competition for mobile resources. In a globalized world, where firms and households become increasingly mobile, reforms that affect these resources negatively might foster them to relocate. If mobile resources are an important determinant to sustain welfare, e.g., due to productivity, tax revenue, positive external effects on other parts of the society etc., governments might implement inefficiently weak reforms or even refrain from realization of reforms.

Policy diffusion, i.e., the adoption of policies previously implemented by other regions, can be observed in various contexts. Empirical evidence for diffusion of environmental regulation is, e.g., given by Konisky (2007). Berry & Berry (1990) find evidence analyzing the introduction of state lotteries. Brülhart & Parchet (2014) focus on the introduction of bequest taxation in different cantons in Switzerland. The literature on political sciences provides various explanations for policy diffusion. The driving forces to adopt policies can be social learning, economic competition, imitation or coercion (see Shipan & Volden (2008) for a detailed explanation). In a recent paper, Callander & Harstad (2015) analyze policy diffusion when social learning and, therefore, incomplete information is the underlying mechanism of policy adoption. They derive equilibria of reform experimentation under different political systems providing conditions under which policy convergence is observed. As highlighted by Boehmke & Witmer (2004), “[...] *there is no reason to expect economic and social learning diffusion to have the same effect on state policy adoption.*” This paper, therefore, complements the results of Callander & Harstad (2015) analyzing a model with complete information where policy diffusion is driven by competition for mobile resources. In contrast to Callander & Harstad (2015), economic competition always implies that the region that has initially a lower reform quality will adopt the higher reform quality of the opponent. As an implication of this result, convergence towards higher regulation can be explained by social learning and competition for mobile resources. Adoption of low regulation and non-convergence, however, cannot be explained in a scenario where regions compete for mobile resources but can result if the driving force of policy diffusion is uncertainty. The paper, therefore, helps to disentangle different explanations of policy diffusion.

A second contribution of this paper is to explain low response elasticities as a consequence of policy convergence and forward-looking agents. Low response elasticities are observed in various contexts. The literature on environmental regulation states the pollution haven hypothesis describing that firms will relocate to regions where environmental regulation is weak. The empirical evidence for the pollution haven hypothesis, however, is at least mixed (see e.g. Hanna (2010) and Kheder & Zugravu (2012)). Similarly, Brülhart & Parchet (2014) find only small responses to the introduction of a bequest tax for rich, elderly individuals in Switzerland. They, therefore, conclude: “*The alleged pressures of tax competition did not seem in reality to exist.*” This paper, in

contrast, shows that competition for mobile resources and low response elasticities are no contradiction if policies converge and mobile resources correctly anticipate this development.

Finally, the paper also relates to the literature on competition for mobile resources. This literature goes back to the seminal papers by Zodrow & Mieszkowski (1986) and Wilson (1986). The literature on competition for mobile resources mainly focuses on simultaneous decision making, although recent literature has endogenized the leadership in tax competition (see Kempf & Rota-Graziosi (2010) and Ogawa (2013)). None of these papers, however, allows for policy adoption which is per definition less costly than initiating a reform from scratch. This paper shows that policy adoption can lead to asymmetric reform decisions even in a scenario with completely symmetric regions. In addition, I replicate the result that an increase in resource mobility, *ceteris paribus*, leads to a decrease in reform quality; a result known as the race to the bottom. I show, moreover, that the direct effect on the reform quality can be mitigated or strengthened due to a change in the reform quantity. A change in the quantity of reforms can directly be interpreted as a change in the likelihood of leadership structures; a question recently tackled by Mideksa (2016) in the context of environmental regulation.

The remaining analysis proceeds as follows: Section 2 provides some examples of application. Afterwards, Section 3 develops a general model of policy diffusion with competition for mobile resources. The subgame perfect equilibria of this model are derived in Section 4. The effects of an increase in the mobility of resources on the quantity and quality of reforms are analyzed in Section 5. Section 6, finally, concludes.

2 Examples

Before describing the model and analyzing the equilibrium outcomes in detail, I provide some examples of application for policy diffusion and the competition for mobile resources.

In the context of environmental regulation the governments' objective might be to reduce environmental pollution. An increase in regulation, however, might drive some firms out of the region. The government's decision process can be separated into three stages: First, it chooses the general kind of reform. There are different possibilities to cope with environmental pollution. The government can, e.g., levy a tax on polluting output, introduce a cap on pollution or implement a certification trade. Deciding on the kind of reform, of course, already comes with some fixed costs. Second, the government decides on the specific design of the chosen reform, e.g., on the level of the tax rate. The quality of the reform, finally, determines the costs due to relocating firms. Third, if a government decides not to initiate a reform process, it nevertheless might decide afterwards to adopt the reform introduced by other governments. In this case we observe diffusion of environmental regulation (see, e.g., Konisky (2007)).

As another example we might think of a reform designed to reduce profit shifting of multinational firms. The government might first decide whether it wants to tighten rules for disclosure, to introduce thin capitalization rules or to implement rules for controlled foreign corporations (CFC). Afterwards, the government decides about the specific design of the respective policy. Finally, mobile resources can also be individuals. In this case the governments' objective might be an increase in redistribution that affects rich individuals negatively. There is some evidence that especially rich individuals change their country of residence if targeted by an increase in the income tax (Kleven et al. (2013)). In this scenario the set of policy instruments might contain an increase in the top marginal tax rate, a wealth tax or, as analyzed in Brühlhart & Paret (2014), bequest taxation.

3 The model

There are two symmetric regions $k \in \{A, B\}$ deciding about a reform that affects a mobile factor (e.g., firms or individuals) negatively. Initially, each region consists of a unit mass of the mobile resource where mobile resources might relocate between the two regions due to differences in reform quality (e.g., strength of regulation). Regulation in period $t = 1, 2$ in region k is denoted by $r_{kt} \in \mathbb{R}_{\geq 0}$. The ideal point of regulation is defined as the welfare maximizing reform quality when resources would be completely immobile. Mobile resources can be relocated between regions where relocation is costly and resources are heterogeneous with respect to these relocation costs θ . Initially relocation costs within each region are identical independent distributed with uniform distribution and support on $[0, \bar{\theta}]$. The parameter $\bar{\theta}$ determines the degree of mobility, i.e., the lower this parameter is the higher is the degree of mobility. For simplicity reasons, I assume that individual relocation costs are not affected by previous relocations. Differences in the payoffs the mobile resources can generate in both regions are exclusively driven by the strength of regulation, that is, there are no additional locational advantages. I denote the payoff that a mobile resource generates in period t in region k as $V(r_{kt})$ where $\partial V / \partial r_{kt} < 0$. The more severe a reform is the lower is the payoff that mobile resources can generate. Anticipating potential relocation of mobile resources a region decides about its reform process. The government's decision process hereby consists of three stages and follows the timing implemented in Callander & Harstad (2015): In period 1 each region firstly decides whether to start a reform process or not. Starting a reform process implies fixed costs F . Afterwards, if a region has started a reform process it has to decide about the severity of the regulation, i.e., about $r_{k1} \in \mathbb{R}_{\geq 0}$. I refer to these two stages of the reform process as the quantity of reforms and the quality of reforms, respectively. Finally, in period 2, each region decides whether to stay with its current regulation or to adopt the regulation of the other region, i.e., $r_{k2} \in \{r_{A1}, r_{B1}\}$. Adoption is assumed to be costless although the results are qualitatively robust as long as adoption of a policy is less costly

than introducing the policy from scratch. The fact that adoption is less costly, however, is crucial for the analysis. It can be justified by a reduction in uncertainty or by an easier conviction of a majority of voters although neither of these arguments is explicitly modeled hereafter. Deciding about the reform governments face a trade-off: On the one hand, they want to implement a severe reform that is close to an ideal point. On the other hand, the fraction of mobile resources located in the region and, therefore, the base to generate welfare (e.g., due to tax revenue) decreases in the severity of the reform. More precisely, each government maximizes net welfare generated due to the reform, i.e.

$$n_{kt}W(r_{kt}), \tag{1}$$

where $n_{kt} \equiv n_{kt}(r_{A1}, r_{B1}, r_{A2}, r_{B2})$ is the fraction of mobile resources located in region k at the end of period t . The fraction of mobile resources in region k depends on the current reform in region k as well as on the reform in the other region. Moreover, the fraction of mobile resources in period 1 depends on the (correctly) anticipated reforms in period 2. The fraction of mobile resources in period 2 depends on the relocation observed in period 1 and, therefore, on the regulations implemented in period 1. The net welfare generated by each single mobile entity is denoted by $W(r_{kt})$ and captures a general trade-off between benefits and costs of implementing some regulation. Net welfare generated by each single mobile entity is inversely U-shaped, i.e., it is a concave function increasing in r_{kt} for small values and decreasing in r_{kt} for large values. Without any reform, i.e., in the initial situation, governments realize some positive welfare due to the location of a mobile entity, i.e., $W(0) > 0$. As an example, we might think of a reform that tightens the disclosure obligations for multinational corporations in order to reduce profit shifting. The reform increases the reported profits and, therefore, the tax revenue but, in addition, implies costs of implementation, monitoring etc. The net effect per cooperation captures the net welfare $W(\cdot)$. The optimal reform severity without relocation of mobile resources determines the benchmark which is called ideal point.

Definition 1 *The ideal point \hat{r} is the reform that government k would choose without relocation of mobile resources, that is, \hat{r} solves*

$$n_{kt} \frac{\partial W(r_{kt})}{\partial r_{kt}} = 0, \tag{2}$$

that is, the ideal point does not depend on the fraction of mobile resources and is, therefore, constant over time.² Since the welfare function is assumed to be the same in both regions, the ideal point is the same in both regions. Before I start solving the game by backward induction, I summarize the timing of the model:

²Note, this result depends on the implicit assumption that both welfare gains and costs are linear in the fraction of mobile resources.

Period 1:

1. *Quantity of reforms:* Both regions simultaneously decide whether to start a reform ($I_k = 1$) or not ($I_k = 0$).
2. *Quality of reforms:* Regions that have started a reform decide about the severity of the reform $r_{k1} \in \mathbb{R}_{\geq 0}$. If a region has not started a reform, regulation is zero, i.e., $r_{k1} = 0$.
3. Mobile resources decide whether to relocate to the other region or to stay in their current region.

Period 2:

4. *Policy adoption:* Both regions decide whether to adopt the reform of the other region or to stay with their reform implemented in period 1. It is $r_{k2} \in \{r_{A1}, r_{B1}\}$.
5. Mobile resources decide again whether to relocate or to stay.

Proposition 1 summarizes as a benchmark the optimal reform processes if resources are completely immobile.

Proposition 1 *Assume that resources are completely immobile. If fixed costs are sufficiently small, i.e., $F \leq 2W(\hat{r})$, both regions implement a reform at the ideal point \hat{r} in the first period and stay with this policy in the second period. There is no relocation. If $F > 2W(\hat{r})$, no reform process is initiated.*

4 Subgame perfect equilibria

4.1 Relocation in the second period (stage 5)

At this stage the final reform of both regions is known to the mobile resources. Mobile resources compare their net payoffs from staying in the current region with the net payoffs they can realize if they move to the other region. A mobile entity with relocation costs θ currently located in region k will move to region k' if

$$\theta \leq V(r_{k'2}) - V(r_{k2}). \quad (3)$$

The relocation costs that make a mobile entity indifferent between staying in period 2 in region k and relocating to region k' is denoted by $\hat{\theta}_{k \rightarrow k', 2}$. If both regions have implemented the same regulation in the second period, there is no relocation of mobile resources. If there is relocation due to differences in the reform, relocation goes from the region with a more severe reform to the region with a less severe reform. The fraction of mobile resources that relocates depends on the first period relocation which affects the distribution of the relocation costs that a region faces in period 2.

As long as regions are initially symmetric, results are not restricted by assuming that region A implements the weakly higher regulation in period 1. I formally summarize this point by Assumption 1.

Assumption 1 *Region A implements a (weakly) more severe reform in period 1, i.e., $r_{A1} \geq r_{B1}$.*

For simplicity reasons, I also rule out situations in which all mobile resources leave a region. More precisely, I assume that some mobile resources have costs that are so high that they do not relocate even if they could realize the lowest reform quality instead of the ideal point in both periods. This restriction is formalized by Assumption 2. It ensures that the fraction of resources that relocates is always well defined.

Assumption 2 *Relocation cost fulfill $\bar{\theta} \geq 2[V(0) - V(\hat{r})]$.*

If there has been no relocation of mobile resources in period 1, i.e., if $r_{A1} = r_{B1}$, the fraction of mobile resources relocating from region k to k' in period 2 is

$$\tilde{n}_{k \rightarrow k', 2} = \frac{V(r_{k'2}) - V(r_{k2})}{\bar{\theta}}. \quad (4)$$

If regions differ in their regulation in the first period, i.e., if $r_{A1} > r_{B1}$, the distribution of relocation costs at the beginning of period 2 is $\mathcal{U}[\hat{\theta}_{A \rightarrow B, 1}, \bar{\theta}]$ in region A and the sum of $\mathcal{U}[0, \hat{\theta}_{A \rightarrow B, 1}]$ and $\mathcal{U}[0, \bar{\theta}]$ in region B , where $\hat{\theta}_{A \rightarrow B, 1}$ denotes the critical costs that make a mobile entity in period 1 indifferent between relocating from region A to region B and staying in region A .

4.2 Policy adoption (stage 4)

At this stage regions decide whether they stay with the regulation they have implemented in period 1 or to adopt the policy introduced by the other region. There are two possible scenarios of policy convergence in period 2. If both regions implement the more severe reform, it is $(r_{A2}, r_{B2}) = (r_{A1}, r_{A1})$. If they both implement the less severe reform, it is $(r_{A2}, r_{B2}) = (r_{B1}, r_{B1})$. In addition, both regions might stay with their initial decisions, i.e., $(r_{A2}, r_{B2}) = (r_{A1}, r_{B1})$, or might both adopt the reform that has previously been implemented by the other region, i.e., $(r_{A2}, r_{B2}) = (r_{B1}, r_{A1})$.

If both regions have implemented the same reform in period 1, i.e., if $r_{A1} = r_{B1} \equiv r_1$, there is a unique Nash equilibrium at stage 4 where both regions set $r_{A2} = r_{B2} = r_1$. Now suppose, instead, region A has implemented a higher regulation in period 1 than region B , i.e., $r_{A1} > r_{B1}$. Given that region k' sets r_{A1} region k chooses r_{A1} if

$$n_{k1}W(r_{A1}) \geq (n_{k1} + \tilde{n}_{k' \rightarrow k, 2})W(r_{B1}). \quad (5)$$

We can rewrite the condition as

$$\frac{W(r_{A1})}{W(r_{B1})} \geq \frac{n_{k1} + \tilde{n}_{k' \rightarrow k,2}}{n_{k1}}, \quad (6)$$

where the LHS of the inequality denotes the relative gain of a more severe reform due to being closer to the ideal point and the RHS is the relative gain of a less severe reform due to the attraction of mobile resources. Given that the opponent chooses the more severe reform in period 2, region A has a stronger incentive to deviate to the less severe reform for two reasons: First, due to Assumption 1 a lower fraction of mobile resources is located in region A at the end of period 1. Since the benefit of a high reform quality increases in the fraction of mobile entities, region B benefits more by the implementation of the more severe reform. Second, due to relocation in the first period there are more mobile resources with low relocation costs located in region B at the beginning of period 2. Thus, region A can attract more mobile entities if it deviates to the low regulation.

Analogously, given that region k' sets r_{B1} region k chooses r_{A1} if

$$(n_{k1} - \tilde{n}_{k \rightarrow k',2}) W(r_{A1}) \geq n_{k1} W(r_{B1}), \quad (7)$$

which we can again rewrite as

$$\frac{W(r_{A1})}{W(r_{B1})} \geq \frac{n_{k1}}{n_{k1} - \tilde{n}_{k \rightarrow k',2}}, \quad (8)$$

where the LHS of the inequality again denotes the relative gain of a more severe reform due to being closer to the ideal point and the RHS is the relative loss of a more severe reform due to a loss of mobile resources.

Inequalities (6) and (8) determine the reaction functions of both regions in period 2 and, therefore, the Nash equilibrium at this stage. We can rule out (r_{A1}, r_{B1}) as an equilibrium outcome by the following argumentation: This equilibrium requires

$$\frac{W(r_{A1})}{W(r_{B1})} \geq \frac{n_{A1}}{n_{A1} - \tilde{n}_{A \rightarrow B,2}} \quad (9)$$

and

$$\frac{W(r_{A1})}{W(r_{B1})} \leq \frac{n_{B1} + \tilde{n}_{A \rightarrow B,2}}{n_{B1}}. \quad (10)$$

Combining both inequalities gives

$$\frac{n_{B1} + \tilde{n}_{A \rightarrow B,2}}{n_{B1}} \geq \frac{n_{A1}}{n_{A1} - \tilde{n}_{A \rightarrow B,2}} \quad (11)$$

and, therefore, $n_{A1} - n_{B1} - n_{A \rightarrow B, 2} > 0$. This inequality, however, never holds if $r_{A1} > r_{B1}$ and, therefore, $n_{A1} < n_{B1}$.

Some implications of the analysis above: First, there is an asymmetry between losing mobile resources and attracting mobile resources. Giving a fixed fraction of mobile resources a region's welfare decreases due to a loss of a marginal mobile entity by $W(r_{B1})$. It increases due to the attraction of a marginal entity by $W(r_{A1})$. A region's welfare is reduced more if it loses resources than it is increased due to the attraction of resources. Second, the benefit of a more severe reform (that is the benefit of being closer to the ideal point) is larger the higher the fraction of mobile resources already located in the region. In contrast to the literature explaining policy diffusion by social learning, differences in reform qualities in the first period trigger economic activities, i.e., relocation of mobile entities, that lead to asymmetric reform incentives in the second period.

4.3 Relocation in the first period (stage 3)

At this stage mobile resources observe regulations implemented in period 1, i.e., (r_{A1}, r_{B1}) with $r_{A1} \geq r_{B1}$, and correctly anticipate the reforms realized in period 2. If both regions have implemented the same regulation, i.e., if $r_{A1} = r_{B1}$, no mobile entity moves and reforms will not change (or more precisely cannot change) in period 2. If $r_{A1} > r_{B1}$, there are at least some mobile entities that will move from region A to B even if they expect that region B realizes the more severe reform in the next period. Given anticipations of the regulation in period 2 relocation in period 1 can be described as follows:

If policy convergence (superscript con) is anticipated, i.e., if reforms in the second period are (r_{A1}, r_{A1}) or (r_{B1}, r_{B1}) , relocation costs that make a mobile entity indifferent between staying in region A or relocating to region B are

$$\hat{\theta}_{A \rightarrow B, 1}^{\text{con}} = V(r_{B1}) - V(r_{A1}). \quad (12)$$

Mobile resources compare the one period benefit of having a less severe regulation (r_{B1} instead of r_{A1}) with the costs realized due to relocation. The respective fraction of relocating mobile resources is

$$\tilde{n}_{A \rightarrow B, 1}^{\text{con}} = \frac{V(r_{B1}) - V(r_{A1})}{\hat{\theta}}. \quad (13)$$

If policies do not converge (superscript non-con), both adopt the policy of the opponent, i.e., it is (r_{B1}, r_{A1}) in the second period, because an equilibrium where both regions stay with their current policy has been ruled out at stage 4. Anticipating this equilibrium in the second period, relocating in period 1 can only be beneficial for a mobile entity if it relocates again in period 2. Relocation costs that make a mobile entity indifferent between staying in region A and relocating to region B are

$$\hat{\theta}_{A \rightarrow B, 1}^{\text{non-con}} = \frac{1}{2} [V(r_{B1}) - V(r_{A1})]. \quad (14)$$

Mobile resources can benefit from a lower regulation by staying in the current region. To generate an additional benefit of $V(r_{B1}) - V(r_{A1})$ they must relocate in both periods. The respective fraction of relocating mobile resources is

$$\tilde{n}_{A \rightarrow B,1}^{\text{non-con}} = \frac{V(r_{B1}) - V(r_{A1})}{2\bar{\theta}}. \quad (15)$$

The critical relocation costs $\hat{\theta}_{A \rightarrow B,1}^{\text{con}}$ and $\hat{\theta}_{A \rightarrow B,1}^{\text{non-con}}$, respectively, are based on the assumption that mobile entities are forward-looking and anticipate future policies correctly. Removing this assumption, the fraction of mobile resources relocating from region A to region B is $\frac{2(V(r_{B1}) - V(r_{A1}))}{\theta}$. Thus, if mobile resources were myopic, response elasticities would be higher. Since (r_{A1}, r_{B1}) cannot be an equilibrium in period 2, there is always some adoption of policies in equilibrium. This result directly links to the discussion taken up by Brühlhart & Parchet (2014). Estimating low response elasticities of individuals regarding a reform of bequest taxation in Switzerland, they conclude that there is no competition for mobile resources. The previous analysis, however, shows that in a scenario with policy diffusion and forward-looking agents low response elasticities are in no way evidence for the absence of competition for mobile resources. Lemma 1 summarizes this result.

Lemma 1 *With policy diffusion and mobile entities that are forward-looking, relocation is smaller than with myopic entities or in a scenario where entities are forward-looking but policies do not diffuse.*

Proof: The proof follows directly by comparing $\hat{\theta}_{A \rightarrow B,1}^{\text{con}}$ and $\hat{\theta}_{A \rightarrow B,1}^{\text{non-con}}$, respectively, with the critical cost level that arises if entities are myopic or policy would not diffuse (i.e., if the policies in period 2 are (r_{A1}, r_{B1})). In both cases the critical relocation costs are $2(V(r_{B1}) - V(r_{A1}))$. \square

Lemma 1 emphasizes the role of expectations interpreting response elasticities. In the context of tax competition this point has recently been mentioned by Langenmayr & Simmler (2016).³ They argue that firms anticipate future policies when they make their relocation decision. Wedges between the current tax rates can, therefore, only partly explain the potential mobility of firms.

Knowing the relocation behavior in period 1 we can rule out some potential equilibria discussed at stage 4. Lemma 2 summarizes this result.

Lemma 2 *With Assumption 1 the unique equilibrium of reforms in the second period is (r_{A1}, r_{A1}) .*

³A preliminary version of the working paper “Why the current tax rate tells you little: competing for mobile and immobile firms” is available at <http://www.sv.uio.no/econ/english/research/centres/ofs/news-and-events/events/2016/langenmayr1111.html>.

Proof: See the Appendix.

In contrast to Callander & Harstad (2015) who analyze policy diffusion in a setup with incomplete information and social learning, competition for mobile resources leads to a unique policy outcome in the adoption period; convergence to high regulation. Callander & Harstad (2015) provide conditions under which the four possible reform outcomes stated in the analysis of stage 4 result in a decentralized solution. I can, therefore, raise Hypothesis 1.

Hypothesis 1 *Policy convergence towards the more severe regulation can be explained by social learning and competition for mobile resources. Policy convergence towards the weaker regulation or non-convergence of policies cannot be explained within the present framework of economic competition but in the context of social learning.*

Hypothesis 1 helps to disentangle the reasons for policy diffusion that is widely observed in reality. If regions sequentially adopt a weak standard or regulation previously implemented by some other region, this cannot be explained in the current setup with complete information where policy adoption is based on economic competition. It is, however, in line with the results in Callander & Harstad (2015) analyzing policy adoption in the context of uncertainty and social learning. Note that Lemma 2 is not in contrast with the standard result of the literature on tax competition that predicts a race to the bottom due to an increase in the mobility of resources (see, e.g., seminal papers by Zodrow & Mieszkowski (1986) and Wilson (1986)). I analyze the effects of an increase in the mobility of resources on the quality of the reforms in Section 5.

4.4 Quality of reforms in the first period (stage 2)

At this stage, regions that have started a reform process decide about the quality of their reform in the first period. Two different cases can arise: First, only one region has initiated a reform process (by Assumption 1 region A) and $r_{B1} = 0$. Second, both regions have started reform processes at stage 1 and, therefore, choose their reform quality simultaneously at this stage of the game. It can never be optimal to choose a reform quality higher than the ideal point. For a given reform quality of the other region any $r_{i1} > \hat{r}$ is strictly dominated by \hat{r} since welfare is increased due to being closer to the ideal point and due to losing fewer mobile resources. The remaining analysis, therefore, focuses on strategies $r_{i1} \leq \hat{r}$.

Suppose first that solely region A has invested in the reform process at stage 1. Region A anticipates policy convergence, i.e., (r_{A1}, r_{A1}) , in period 2 and that there is no relocation in the second period. It, therefore, maximizes

$$2 \cdot n_{A1}(r_{A1}, 0, r_{A1}, r_{A1}) \cdot W(r_{A1}). \quad (16)$$

Suppressing the determinants of n_{A1} , the respective first-order condition reads

$$2 \frac{\partial n_{A1}}{\partial r_{A1}} W(r_{A1}) + 2n_{A1} \frac{\partial W(r_{A1})}{\partial r_{A1}} = 0. \quad (17)$$

With

$$\frac{\partial n_{A1}}{\partial r_{A1}} = \frac{\partial V(r_{A1})}{\partial r_{A1}} \cdot \frac{1}{\bar{\theta}} \quad (18)$$

and

$$n_{A1} = 1 - \tilde{n}_{A \rightarrow B,1} = 1 - \frac{V(0) - V(r_{A1})}{\bar{\theta}} \quad (19)$$

the first-order condition can be rewritten as

$$\left[1 - \frac{V(0) - V(r_{A1})}{\bar{\theta}} \right] \frac{\partial W(r_{A1})}{\partial r_{A1}} = - \frac{\partial V(r_{A1})}{\partial r_{A1}} \cdot \frac{1}{\bar{\theta}} \cdot W(r_{A1}). \quad (20)$$

The solution of this first-order condition is denoted by r_{A1}^s . Due to relocation in the first period the implemented reform quality is lower than the ideal point (see first term of (17)), i.e., $r_{A1}^s < \hat{r}$. This result illustrates the general trade-off between implementing a reform quality that is close to the ideal point but does not trigger to much relocation.

Suppose now that both regions have started a reform process in period 1. With Assumption 1, anticipating that the reform equilibrium in the second period is (r_{A1}, r_{A1}) (see Lemma 2), and given r_{B1} , the first-order condition for region A reads

$$2 \frac{\partial n_{A1}}{\partial r_{A1}} W(r_{A1}) + 2n_{A1} \frac{\partial W(r_{A1})}{\partial r_{A1}} = 0 \quad (21)$$

with $n_{A1} = n_{A1}(r_{A1}, r_{B1}, r_{A1}, r_{A1})$.

Similarly, the first-order condition for region B reads

$$\frac{\partial n_{B1}}{\partial r_{B1}} [W(r_{A1}) + W(r_{B1})] + n_{B1} \frac{\partial W(r_{B1})}{\partial r_{B1}} = 0 \quad (22)$$

with $n_{B1} = n_{B1}(r_{A1}, r_{B1}, r_{A1}, r_{A1})$. The reaction functions of the two regions determine the Nash equilibrium at stage 2 if both regions have initiated a reform process. Lemma 3 proves the existence and uniqueness of the equilibrium at stage 2. I will denote the equilibrium by (r_{A1}^b, r_{B1}^b) .

Lemma 3 *With Assumption 1 there is always a unique asymmetric reform equilibrium at stage 2 independent of the quantity of reforms. A higher reform quantity leads (ceteris paribus) to a higher reform quality in region A and, therefore, to a higher common reform quality in the second period.*

Proof: See the Appendix.

4.5 Quantity of reforms in the first period (stage 1)

At this stage three scenarios can arise depending on the level of fixed costs necessary to initiate a reform process. First, there might be no reform at all because of very high fixed costs. Second, only region A might initiate a reform process while region B does not. Region B anticipates that, if it does not start a reform process, it can attract more mobile resources but faces a lower reform quality (fixed by region A) in the second period. In this case the reform quantity is low. Third, both regions might initiate a reform process if fixed costs are sufficiently low so that there is a high quantity of reforms. With Assumption 1 and given that region B initiates a reform, region A does so too if

$$2n_{A1}(r_{A1}^b, r_{B1}^b)W(r_{A1}^b) - F \geq n_{A1}(0, r_{B1}^s) [W(0) + W(r_{B1}^s)] \quad (23)$$

where r_{B1}^s is analogously to r_{A1}^s defined by (20) with region B being the region initiating the single reform. If condition (23) holds with equality, it defines a critical cost level F_A^b so that region A , anticipating that region B initiates a reform, is indifferent between starting a reform or not. Analogously, given region A starts a reform process region B also reforms if

$$n_{B1}(r_{A1}^b, r_{B1}^b) [W(r_{B1}^b) + W(r_{A1}^b)] - F \geq n_{B1}(r_{A1}^s, 0) [W(0) + W(r_{A1}^s)] \quad (24)$$

which defines with equality the critical fixed costs level F_B^b . Given that region B is better off than region A in an equilibrium where both reform and taking into account that $n_{A1}(0, r_{B1}^s) = n_{B1}(r_{A1}^s, 0)$ and $r_{B1}^s = r_{A1}^s$, it is $F_B^b > F_A^b$. Thus, if fixed costs are sufficiently small, i.e., if $F \leq F_A^b$, both regions initiate a process in the first period implying a high quantity of reforms.

Given that region B does not initiate a reform, region A initiates a reform process if

$$2n_{A1}(r_{A1}^s, 0)W(r_{A1}^s) - F \geq 2W(0) \quad (25)$$

which defines with equality the critical fixed costs level F_A^s . Lemma 4 summarizes these results.

Lemma 4 *Take Assumption 1 as given. If fixed costs are sufficiently low, i.e., if $F < F_A^b$, both regions initiate a reform. If fixed costs fulfill $F_B^b \leq F \leq F_A^s$, only region A initiates a reform. If $F \geq F_A^s$, there is no reform at all.*

Proof: The proof follows directly by the reaction functions described above. \square

Based on the previous analysis three different subgame perfect equilibria in pure strategies can arise. Proposition 2 summarizes all potential equilibrium paths depending on the level of fixed costs that are necessary to initiate a reform.

Proposition 2 *With Assumption 1 any subgame perfect equilibrium in pure strategies is characterized by one of the following equilibrium paths:*

If $F < F_A^b$, there is a high quantity of reforms with reform qualities (r_{A1}^b, r_{B1}^b) and (r_{A1}^b, r_{A1}^b) in periods 1 and 2, respectively. Mobile resources with $\theta \leq V(r_{B1}^b) - V(r_{A1}^b)$ relocate from A to B in period 1. There is no relocation in period 2.

If $F_B^b \leq F \leq F_A^s$, there is a low quantity of reforms with reform qualities $(r_{A1}^s, 0)$ and (r_{A1}^s, r_{A1}^s) in periods 1 and 2, respectively. Mobile resources with $\theta \leq V(0) - V(r_{A1}^s)$ relocate from A to B in period 1. There is no relocation in period 2.

If $F \geq F_A^s$, no reform process is initiated, reform qualities are zero in both periods and there is no relocation.

Proof: The proof follows by Lemma 2 – 4 and by the two conditions determining the relocation of mobile resources in periods 1 and 2, respectively (see conditions (3) and (12)). \square

Proposition 2 shows that high fixed costs lead to a situation where both regions are trapped in their current situation facing zero reform quality. If fixed costs necessary to initiate a reform are sufficiently low, both regions initiate a reform process where one region (per assumption region B) implements a lower reform quality than the other region in the first period to attract some mobile resources. Afterwards, in period 2 it will adopt the reform quality of the other region without losing mobile resources. If, finally, the reform quantity is low, region A implements a lower reform quality in the first period than with a high quantity of reforms. There is again relocation of mobile resources in period 1 but – due to policy convergence – not in period 2. It remains to show that all three potential equilibria exist. Existence of the subgame game perfect equilibria is determined by the comparison of the critical fixed costs levels and is still work in progress. In general, there can be conditions so that no subgame perfect equilibrium in pure strategies exists.

5 The effects of mobility on the quantity and quality of reforms

Since competition for mobile resources is the driving force that prevents regions from implementing the ideal point, the degree of mobility determines the reform quality. The degree of mobility is captured by the parameter $\bar{\theta}$ where a high value of $\bar{\theta}$ implies low mobility. From the first-order condition that defines the optimal reform quality in the case where only region A initiates a reform, i.e., from (20), we directly infer $\partial r_{A1}^s / \partial \bar{\theta} > 0$. Moreover, in the case with two reforms in the first period both reaction functions given in

(21) and (22) are upward shifted due to an increase in $\bar{\theta}$, i.e., $\partial r_{A1}^b / \partial \bar{\theta} > 0$ and $\partial r_{B1}^b / \partial \bar{\theta} > 0$. As a direct effect, an increase in the mobility of resources, i.e., a decrease in $\bar{\theta}$, leads to a reduction of the reform quality realized in the first period and, therefore, to a decrease of the common reform quality in the second period. There is, however, an additional indirect effect due to a potential change in the quantity of reforms since the quality of reforms is, *ceteris paribus*, lower if only region A initiates a reform (see Lemma 3). The likelihood of an equilibrium where both regions initiate a reform decreases in the mobility of resources, i.e., it increases in $\bar{\theta}$, if the critical fixed costs F_A^b increase in $\bar{\theta}$. Differentiating (23) with respect to $\bar{\theta}$, we obtain that $\frac{\partial F_A^s}{\partial \bar{\theta}} \geq 0$ is equivalent to⁴

$$\begin{aligned} & \underbrace{2 \frac{dn_{A1}(r_{A1}^b, r_{B1}^b)}{d\bar{\theta}} W(r_{A1}^b) + 2n_{A1}(r_{A1}^b, r_{B1}^b) \frac{dW(r_{A1}^b)}{d\bar{\theta}}}_{>0} \\ & \geq \underbrace{\frac{dn_{A1}(0, r_{B1}^s)}{d\bar{\theta}} [W(0) + W(r_{B1}^s)]}_{<0} + \underbrace{n_{A1}(0, r_{B1}^s) \frac{dW(r_{B1}^s)}{d\bar{\theta}}}_{>0}. \end{aligned} \quad (26)$$

The LHS of the inequality describes the change in region A 's welfare due to a change in mobility when both regions initiate a reform. This effect is positive because we can rewrite the LHS as

$$\begin{aligned} & 2 \left[\frac{\partial n_{A1}(r_{A1}^b, r_{B1}^b)}{\partial \bar{\theta}} + \frac{\partial n_{A1}(r_{A1}^b, r_{B1}^b)}{r_{A1}^b} \frac{\partial r_{A1}^b}{\partial \bar{\theta}} + \frac{\partial n_{A1}(r_{A1}^b, r_{B1}^b)}{r_{B1}^b} \frac{\partial r_{B1}^b}{\partial \bar{\theta}} \right] W(r_{A1}^b) \\ & + 2 \frac{\partial W(r_{A1}^b)}{\partial r_{A1}^b} \frac{\partial r_{A1}^b}{\partial \bar{\theta}} \end{aligned} \quad (27)$$

and, finally, using the first-order condition for r_{A1}^b , i.e., (21), as

$$2 \left[\underbrace{\frac{\partial n_{A1}(r_{A1}^b, r_{B1}^b)}{\partial \bar{\theta}}}_{>0} + \underbrace{\frac{\partial n_{A1}(r_{A1}^b, r_{B1}^b)}{r_{B1}^b}}_{>0} \underbrace{\frac{\partial r_{B1}^b}{\partial \bar{\theta}}}_{>0} \right] W(r_{A1}^b) > 0. \quad (28)$$

An increase in $\bar{\theta}$, that is, a decrease in mobility increases the welfare region A can generate if it implements a reform anticipating that region B does so too. The RHS of (26) denotes the effect of a change in mobility on the welfare that region A generates if it does not implement a reform although region B does. Here we obtain two counteracting effects: On the one hand, an increase in $\bar{\theta}$ reduces the fraction of mobile resources that can be attracted and, therefore,

⁴Note that, for simplicity reasons, I suppress the second period reform qualities in the notation of the fraction of mobile resources, i.e., $n_{A1}(r_{A1}^b, r_{B1}^b) \equiv n_{A1}(r_{A1}^b, r_{B1}^b, r_{A1}^b, r_{A1}^b)$.

reduces the fraction of mobile entities because

$$\frac{dn_{A1}(0, r_{B1}^s)}{d\bar{\theta}} = \underbrace{\frac{\partial n_{A1}(0, r_{B1}^s)}{\partial \bar{\theta}}}_{<0} + \underbrace{\frac{\partial n_{A1}(0, r_{B1}^s)}{\partial r_{B1}^s}}_{<0} \underbrace{\frac{\partial r_{B1}^s}{\partial \bar{\theta}}}_{>0} < 0. \quad (29)$$

On the other hand, an increase in $\bar{\theta}$ increases the reform quality implemented by region B , i.e., r_{B1}^s , that benefits region A in the second period. The effect of an increase in the mobility of resources on the likelihood that both regions initiate a reform is ambiguous. If the quantity of reforms decreases in the mobility of resources, the negative direct effect on the reform quality is strengthened. If the quantity of reforms increases in the mobility of resources, the negative direct effect on the reform quality is mitigated and might even be overcompensated. It remains to provide some conditions for which the different scenarios arise.

6 Conclusion

This paper analyzes competition for mobile resources allowing governments to adopt policies that have previously been implemented in other regions. The subgame perfect equilibrium predicts a policy wedge in the first period and, therefore, relocation of mobile resources towards the region with the lower regulation. This region then adopts the high reform quality in the next period. Based on the derived equilibrium strategies it is possible to disentangle (at least partially) whether policy diffusion is driven by economic competition or social learning. While policy convergence towards the high reform quality can be explained by both mechanisms, policy convergence towards the low reform quality cannot be explained by the present model of competition for mobile resources but is in line with the idea that uncertainty makes governments adopt policies previously tested by other governments. The predicted policy convergence and forward-looking entities are, in addition, an explanation for low response elasticities that have been found in various literatures analyzing responses to reforms. Finally, the paper replicates the race to the bottom highlighted in the literature on competition for mobile resources. Beside the direct negative effect of an increase in mobility on reform quality the paper finds an additional indirect effect on reform quality due to a change in the quantity of reforms. If an increase in resource mobility prevents some regions from implementing a reform at all the direct effect on the reform quality is strengthened.

Analyzing the effects of mobility on the reform quantity can also explain leadership structures within reform process (e.g., in the context of environmental regulation). To contribute more to this part of the literature an extension of the basic model might allow for asymmetries between regions (e.g., with respect to the ideal point). Taking asymmetries into account it might not just be possible to find conditions under which it becomes more likely to observe a leader but it might also be possible to provide a testable hypothesis about

the characteristics of leaders.

An additional potential extension of the presented model is to endogenize the ideal point. So far, I have assumed that the governments' welfare function is the aggregate of the welfare generated by each single mobile entity. Due to this assumption the ideal point does not depend on the fraction of mobile entities. This assumption helps to disentangle the general trade-off governments face when they decide about reforms that harm mobile resources. There are, however, scenarios where the ideal point depends on the fraction of the mobile resources currently located in a region. If there are, e.g., a lot of mobile entities and there is, therefore, a lot of pollution, the ideal point might be higher than in a situation where there are only some mobile entities leading to minor effects on the environment. Anticipating that regulation implies that some mobile resources leave the region, the ideal point will decrease making it less costly to increase regulation. Thus, regulation might increase.

Finally, it might be worth to analyze a scenario where the mobile entities have some strategic power. In the context of regional competition for mobile resources, welfare sometimes depends on a few, large entities. In such a scenario there are at least two effects changing the basic model: First, losing an entity comes with high costs for the region which increases the regions' incentive to reduce regulation. Second, entities now anticipate that their relocation has a direct effect on the reform decision in the destination. If the relocation of the mobile entity triggers policy adoption in the destination, it might not move. If a small number of large entities implies higher regulation than an infinite number of small entities, this result could somehow change the role large influential entities usually play in the context of competition for mobile resources.

Appendix

Proof of Lemma 2:

If both regions have implemented the same reform in period 1, i.e. $r_{A1} = r_{B1}$, both regions have to stay with this reform in period 2 by assumption. If $r_{A1} > r_{B1}$ (which includes the case that only region A has initialized a reform process at stage 1), there are three potential equilibria in period 2, i.e., (r_{A1}, r_{A1}) , (r_{B1}, r_{B1}) , and (r_{B1}, r_{A1}) . If policy convergence is anticipated in period 2, there is no relocation of mobile resources in period 2, i.e., $\tilde{n}_{A \rightarrow B, 2} = \tilde{n}_{B \rightarrow A, 2} = 0$. Since with $r_{A1} > r_{B1}$ it is $\frac{W(r_{A1})}{W(r_{B1})} > 1$. The reaction functions given in (6) and (8) then directly give that (r_{B1}, r_{B1}) is never an equilibrium in period 2 while (r_{A1}, r_{A1}) always is. If policy does not converge, the only potential equilibrium outcome in period 2 is (r_{B1}, r_{A1}) . Anticipating this equilibrium relocation in period 2 implies $\tilde{n}_{A \rightarrow B, 2} = 0$ and that region A can attract more mobile resources back than it has lost in period 1 (the critical moving costs in period 2 is larger than in period 1 because moving costs just apply once). By (8) region B chooses r_{A1} anticipating that region A chooses

r_{B1} if

$$\frac{W(r_{A1})}{W(r_{B1})} \geq \frac{n_{B1}}{n_{B1} - \tilde{n}_{B \rightarrow A,2}}. \quad (30)$$

By (6) region A chooses r_{B1} given that region B chooses r_{A1} if

$$\frac{W(r_{A1})}{W(r_{B1})} \leq \frac{n_{A1} + \tilde{n}_{B \rightarrow A,2}}{n_{A1}}. \quad (31)$$

Combining both inequalities we obtain as a necessary condition for the equilibrium to exist

$$\frac{n_{B1}}{n_{B1} - \tilde{n}_{B \rightarrow A,2}} \leq \frac{n_{A1} + \tilde{n}_{B \rightarrow A,2}}{n_{A1}} \quad (32)$$

which can be rewritten as

$$n_{A1} + \tilde{n}_{B \rightarrow A,2} \leq n_{B1} \quad (33)$$

which is never fulfilled since region A attracts more mobile resources back than it has lost in the first period, i.e., $n_{A1} + \tilde{n}_{B \rightarrow A,2} > n_{B1}$. Therefore, (r_{B1}, r_{A1}) cannot be part of an equilibrium. \square

Proof of Lemma 3:

If only region A has initiated a reform at stage 1, its optimal reform quality is defined by the first-order condition given in (17). Region B has per definition a reform quality of zero. It remains to show that there is a unique equilibrium at stage 2 if both regions have initiated a reform process before. The reaction functions of the two regions, i.e., (21) and (22), are continuous. Differentiating both with respect to the other region's reform quality it is

$$\frac{dr_{A1}}{dr_{B1}} = - \frac{\frac{\partial n_{A1}}{\partial r_{B1}} \frac{\partial W(r_{A1})}{\partial r_{A1}}}{\frac{\partial^2 n_{A1}}{\partial r_{A1}^2} W(r_{A1}) + 2 \frac{\partial n_{A1}}{\partial r_{A1}} \frac{\partial W(r_{A1})}{\partial r_{A1}} + n_{A1} \frac{\partial^2 W(r_{A1})}{\partial r_{A1}^2}} > 0 \quad (34)$$

and

$$\frac{dr_{B1}}{dr_{A1}} = - \frac{\frac{\partial n_{B1}}{\partial r_{B1}} \frac{\partial W(r_{A1})}{\partial r_{A1}} + \frac{\partial n_{B1}}{\partial r_{A1}} \frac{\partial W(r_{B1})}{\partial r_{B1}}}{\frac{\partial^2 n_{B1}}{\partial r_{B1}^2} [W(r_{A1}) + W(r_{B1})] + 2 \frac{\partial n_{B1}}{\partial r_{B1}} \frac{\partial W(r_{B1})}{\partial r_{B1}} + n_{B1} \frac{\partial^2 W(r_{B1})}{\partial r_{B1}^2}} \geq 0, \quad (35)$$

respectively. The numerator of (34) is positive because $\frac{\partial W(r_{A1})}{\partial r_{A1}} > 0$ (if $r_{A1} < \hat{r}$) and $\frac{\partial n_{A1}}{\partial r_{B1}} > 0$. The denominator of (34) is negative because of the concavity of the optimization problem. The numerator of (35) is positive because with $r_{A1} \geq r_{B1}$ and $r_{A1} < \hat{r}$ it is $\frac{\partial W(r_{B1})}{\partial r_{B1}} \geq \frac{\partial W(r_{A1})}{\partial r_{A1}} > 0$. Moreover, $\frac{\partial n_{B1}}{\partial r_{B1}} = -\frac{\partial n_{B1}}{\partial r_{A1}}$. The denominator of (35) is negative because of the concavity of the optimization problem. Both response functions are in the relevant interval,

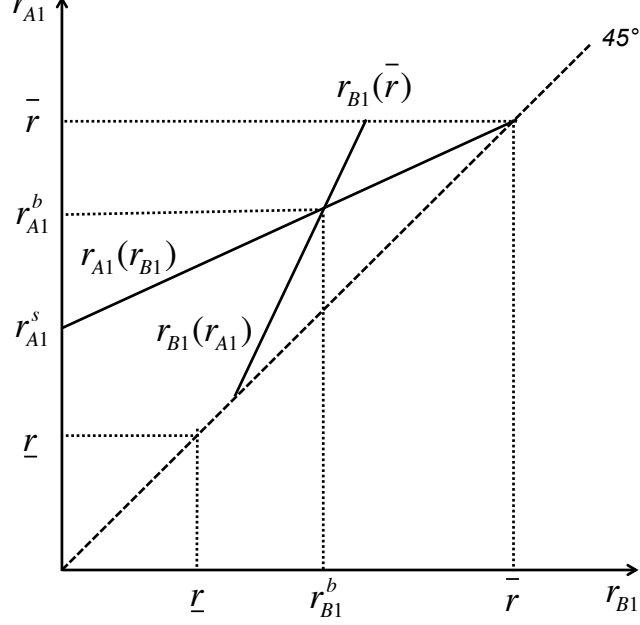


Figure 1: Reaction functions of region A and B

i.e., where $\hat{r} \geq r_{A1} \geq r_{B1}$ holds, continuous and strictly increasing as long as $r_{A1} > r_{B1}$. We denote the reaction functions of region A and B by $r_{A1}(r_{B1})$ and $r_{B1}(r_{A1})$ respectively. As will be proven subsequently, there exist qualities of the reform \bar{r} and $\underline{r} < \bar{r}$ such that region B has an incentive to deviate downwards if region A chooses the high quality \bar{r} and that region A has an incentive to deviate upwards if region B chooses the low quality \underline{r} . Given that these two boundaries for the quality of reform exist and both reaction functions are strictly increasing, the reaction functions of the two regions have a unique point of intersection. Figure 1 illustrates the reaction functions. It remains to show that \bar{r} and \underline{r} with the respective characteristics exist. Let us define \bar{r} as the reaction function of region A given that region B chooses \bar{r} , i.e. \bar{r} solves

$$\frac{\partial W(r_{A1})}{\partial r_{A1}} + \frac{\partial V(r_{A1})}{\partial r_{A1}} \cdot \frac{1}{\theta} \cdot W(r_{A1}) = 0. \quad (36)$$

There is always a solution $\bar{r} < \hat{r}$ of (36), since both regions have an incentive to deviate downwards if the opponent chooses the ideal point. Given that region A chooses \bar{r} region B has an incentive to deviate downwards since

$$\frac{\partial W(\bar{r})}{\partial r_{B1}} + \frac{\partial V(\bar{r})}{\partial r_{B1}} \cdot \frac{1}{\theta} \cdot [W(\bar{r}) + W(\bar{r})] < 0 \quad (37)$$

by using (36) and $\frac{\partial V(\bar{r})}{\partial r_{B1}} \cdot \frac{1}{\theta} \cdot W(\bar{r}) < 0$. Analogously, let us define \underline{r} as the

reaction function of region B given that region A chooses \underline{r} , i.e., \underline{r} solves

$$\frac{\partial W(r_{B1})}{\partial r_{B1}} + \frac{\partial V(r_{B1})}{\partial r_{B1}} \cdot \frac{1}{\theta} \cdot [W(r_{A1}) + W(r_{B1})] = 0 \quad (38)$$

where $r_{A1} = r_{B1}$. There is always a solution $\underline{r} > 0$ of (36), since both regions have an incentive to deviate upwards if the opponent chooses reform quality zero. Moreover, comparing (36) and (38) gives $\underline{r} < \bar{r}$. Given that region B chooses reform quality \underline{r} region A has an incentive to deviate upwards since

$$\frac{\partial W(\underline{r})}{\partial r_{A1}} + \frac{\partial V(\underline{r})}{\partial r_{A1}} \cdot \frac{1}{\theta} \cdot W(\underline{r}) > 0 \quad (39)$$

by using (38) and $-\frac{\partial V(\underline{r})}{\partial r_{A1}} \cdot \frac{1}{\theta} \cdot W(\underline{r}) > 0$. I have proven that there is always a unique equilibrium at stage 2 independent of the quantity of reform processes. Let us define the equilibrium in the case where both regions have initiated a reform process by (r_{A1}^b, r_{B1}^b) . As proven before it is $r_{B1}^b \in (\underline{r}, \bar{r})$. Since the reform quality chosen by region A in the case where it has initiated a reform process solely, i.e., r_{A1}^s , is the reaction to a reform quality of zero by region B and the reaction function of region A is increasing, it is $r_{A1}^b = r_{A1}(r_{B1}^b) > r_{A1}^s$. \square

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