Heterogeneity and Coordination Externalities in Federal Systems[1]

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Abstract

We discuss the welfare properties of unitarian centralisation versus non cooperative decentralisation in a confederation where local policies generate cross-border externalities and local preferences are heterogeneous . Contrary to the literature on fiscal federalism which mostly deal with local public good with either positive or negative spillovers, we focus on coordination externalities which penalize the heterogeneity of policies across the confederation. The comparison of the two regimes highlights a trade-off between the internalization of externalities and the match of local tastes which is familiar in fiscal federalism. However, the comparative statics of the decentralisation debate are quite different. We show that centralisation will never be a Pareto improvement. Moreover, notwithstanding Oates decentralisation theorem, under mild symmetry conditions on the external effects, decentralisation achieves a higher social welfare whatever the severity of externalities and the heterogeneity of preferences.

1 Introduction

When discussing the pros and cons of federalism in the early times of American democracy, Tocqueville ("De la Democratie en Amérique", 1830) pointed out that the main failure of the high degree of administrative decentralisation was a default of policy uniformity. The lack of coherence in the management of local affairs was argued to result in efficiency losses in local administration and federal interventions. Conversely, he didn't consider complete centralisation as fully satisfactory since a unique administration could not embrace all the different wishes and needs of its various constituents. Balancing the social costs of centralisation versus decentralisation — namely restrictive uniformity and inconsistent heterogeneity — Tocqueville concluded that in what he referred to as the administrative sphere, decentralisation would produce a higher level of social welfare in bringing public decisions closer to the citizens's preferences.

About three centuries latter, the appropriate vertical allocation of administrative and political power is still the subject of much debates among specialists although there is few areas in which a consensus has been reached. However, it is commonly argued that cross border externalities cannot be satisfactorily internalised in a decentralized organisation while local differentiation of policy cannot be properly handled at the central level. Hence, most scolars relate the costs and benefits of an integration process respectively to the heterogeneity of national preferences and the internalisation of externalities.

We adopt the same strategy as a large part of the literature on federalism and take the presence of cross border externalities along with heterogeneous preferences as the primitives of our analysis. We depart from it in introducing specific externalities which penalize the heterogeneity of local policies and engage local jurisdictions in a kind of battle of sexes. Traditionally, the political economic literature has mostly dealt with tax competition on mobile factors[1] or local public goods with either positive or negative spillovers that generate a situation similar to the prisoner's dilemma. Such externalities can satisfactorily model the conflict of interest that arises in environmental or fiscal federalism. In those domains, the typical failure of decentralisation is more the underprovision of local public goods than excessive policy heterogeneity for which Tocqueville blamed administrative decentralisation. It has

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[1] See for instance Persson and Tabellini, 1992.

been argued that in the fiscal context, whenever the spillovers are sufficiently high and national preferences are not too diverging, voting over a common policy can be welfare enhancing or even Pareto improving compared to a situation where each jurisdiction chooses non cooperatively its own policy.

In this paper, we follow Tocqueville's perspective and focus on public issues where the heterogeneity of local policies generate externalities. Public administration and economic activity provide numerous examples of such externalities. A recent study from Bruxelles has shown that small and medium European firms have to pay 2.6% of their sales figure to adapt to national accounting norms[2]. In network industries, the diversity of technical standards deter trade and coordinated production. More generally, the heterogeneity of law and administrative rules creates a barrier to interstate cooperation and exchange. Such coordination externalities are not confined to the business sphere, other examples are school curricula, traffic code, languages or even social norms. They give rise to a conflict of interest that can be described in the following way: although local needs or intrinsic preferences differ from one jurisdiction to another, they all suffer from the lack of policy homogeneity, so that they agree that they should harmonise policies but they disagree on the direction of harmonisation. Coordination externalities can be viewed as a political network effect. In this context, a non cooperative decentralised equilibrium typically entail too much policy heterogeneity to be socially optimal.

One obvious way to cope with the cost of heterogeneity is simply to merge the local jurisdictions into a federation with the mandate to implement a uniform policy. Uniformisation may be the only way for districts to bind their hands and internalize externalities in a context of high transaction costs and decentralised information. Monetary unions, official languages, common time zone as in China, or the License-Master-Doctorate qualification system for European universities are obvious examples of coordination trough uniformisation. In the presence of coordination externalities, a common rule will clearly remove externality costs. However, such benefits must be balanced against the impossibility to take into account the diversity of preferences across the confederation. The aim of this paper is to discuss the conflict of interest induced by coordination externalities along with heterogeneous preferences, and assess the relative merits of unitarian centralisation versus non cooperative decentralisation in terms of social welfare. The main insight of our

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[2]Source: Le Figaro économie 13/09/2004

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model is that whenever external effects are sufficiently reciprocal, i.e. when the inconsistencies between two local policies hurts both districts equally, decentralisation will achieve a higher social welfare whatever the severity of externalities and the heterogeneity of preferences. The intuition is that if externalities are reciprocal, under decentralisation, the districts internalize half of the cost they impose to their neighbors.

Formally, we consider a confederation divided into a finite number of district. In each of them, a unidimensional policy has to be implemented. The welfare of local residents decrease in the distance between their own policy and their idiosynchratic ideal point, and in the distance between their own policy and the policy of the other districts. In the first part, we show that the two regimes cannot be Pareto ranked. In particular, unless local preferences are identical, the centralised confederation will not be immune to secession threats from district with extreme preferences. In the second part we focus on the aggregate welfare without paying attention to participation constraints, as if utils could be transferred arbitrarily and at no cost between districts. We examine whether in this optimistic context, a uniform policy with well chosen interdistrict transfers could leave all districts better off than decentralisation. We provide a mild symmetry conditions on the externals effects which is necessary and sufficient for decentralisation to produce a higher surplus than centralisation whatever the distribution of preferences. In the last part, we consider the more realistic case where direct transfers between districts are not feasible and examine the redistributive performance of both allocations of power. We argue that, when compelled to uniformity, centralisation is unlikely to reduce the inequalities that arise under decentralisation between districts with moderate and extreme preferences. We find that if the coordination externalities are uniform and the distribution of districts's ideal policy is symmetric, decentralisation is more Pigou-Dalton redistributive than centralisation, once again, whatever the heterogeneity of preferences and the severity of externalities.

Those results are in sharp contrast with the literature on fiscal and environmental federalism previously mentioned. Since the seminal work of Oates (1972), it is widely accepted that the comparative advantages of centralisation increase with the severity of externalities and decrease with the heterogeneity of preferences. The key difference with our model is that in fiscal federalism, harmonisation is not desirable in itself but has an indirect virtue: in the case of public goods with spillovers, the uniformity constraint makes voters internalize the spillovers and partially solve for the free riding prob-

lem. In the case of fiscal competition, it avoids distortive tax competition. Our results suggest that whenever the prisoner's dilemma turns into a battle of sexes, reciprocities in externalities should be the leading criterion when considering the decentralisation of local policies.

2 The Model

2.1 The Confederation

We consider a confederation exogenously divided into a finite number D of local jurisdictions that we shall call districts. Each of them is inhabited by a set of citizens of any size, possibly a continuum. Let I_d be the set of index of the residents of district d. The confederation population can be represented by $I = \{(i,d), d = 1..D, i \in I_d\}$. The set of alternatives consists in a vector of unidimensional local policy $(x_d)_{d=1..D}$, being x_d the policy prevailing in district d.

The preferences of a citizen are driven by two forces: an idiosyncratic effect which embodies the heterogeneity of preferences across the confederation, and an external effect that penalizes the lack of coordination between the local policy in his district and the policy implemented in the other jurisdictions. We assume that both effects are quadratic, the former in the distance between the local policy and his ideal one $|x_d - t_{i,d}|$, the latter in the distance between the local policy and the policies of the other districts $|x_d - x_\delta|_{\delta \neq d}$

$$U_{i,d}(x) = \left[-(x_d - t_{i,d})^2 \right] + \left[-\sum_{\delta \neq d} \beta_{d,\delta}(x_d - x_\delta)^2 \right], \qquad (1)$$

where $t_{i,d}$ can be any real number and the $\beta_{d,\delta}$'s are non negative. The individual parameter $t_{i,d}$ stands for the particular taste of voter (i,d) on his local policy. The coefficient $\beta_{d,\delta}$ is the magnitude of the externality imposed by the policy implemented in district δ on the citizens of district d. Latter on, we will refer to β as the externality matrix.

When external effects are insignificant, i.e. when $\beta \equiv 0$, preferences depend only on the local policy. They are represented by the usual single peaked utility function[3] $U_{i,d}(x_d) = -(x_d - t_{i,d})^2$. Hence, $t_{i,d}$ can be seen as the

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[3]This profile of preferences has been analyzed in a federal context by Crémer and Palfrey (1996 and 1999).

autarchy bliss point of voter (i, d). In the sequel, we will refer to it as the voter's type. In the presence of coordination externalities, his most preferred policy vector is a uniform vector equal to $(t_{i,d}, .., t_{i,d})$, but taking the other policy as given, his most preferred local policy is a barycenter of its autarchy bliss point with weight 1 and the policy of the other districts with weight $\left(\beta_{d,\delta}\right)_{\delta \neq d}$

$$x_{i,d}^* \left(x_{-d}\right) = \frac{t_{i,d} + \sum_{\delta \neq d} \beta_{d,\delta} x_\delta}{1 + \sum_{\delta \neq d} \beta_{d,\delta}}.$$

Furthermore, we assume that there exists a unique median type t_d within each district[4]

$$t_d \equiv median_{i \in I_d}\left(t_{i,d}\right).$$

Latter on, we shall refer to t_d simply as the type of district d, and to t as the vector of district type.

2.2   The Second Best Approach

In this subsection, we will discuss the specific assumptions we make to describe the political process both at the local and central level. All along this paper, we will stick to Oates's view (1972), namely that under centralisation, the federal policy is compelled to uniformity while under decentralisation, local governments control their own policy and maximize the welfare of their constituents without taking into account the cost for the rest of the confederation. We shall call those two regimes unitarian centralisation and non cooperative decentralisation respectively. Under those hypotheses, both allocations of power are suboptimal: centralisation generates preferences frustration for a unique policy cannot satisfy heterogeneous tastes while under decentralisation, local jurisdictions do not internalize externalities. Since Oates, this second best scenario has been the framework of a large body of literature on federalism. It is based on the recieved wisdom that centralised organisations entail more coordination and rigidity while decentralised ones are more flexible at the expenses of internal consistency and efficiency. Although we think that this managerial intuition can be considered as a reasonnable approximation, there is no clear rationale for why the central and local authority would

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[4]Hence I_d can be a finite set or a continuum.

behave in such a way. This issue is the subject of a companion paper, Loeper 2005, to which we refer the reader for a more extensive and formal discussion. For expository purposes, let us briefly review the informal arguments that support this modelisation strategy and some of the criticisms that has been made so far in the political and economic literature.

The question of the nature of the central intervention and the control of political power goes back to the controversy between Pigou and Oates. On the one hand, if there exists a benevolent and omniscient central planner, there is no reason why he would restrict its attention to uniform policies. He could rather apply some form of pigouvian taxation to correct the failures of complete decentralisation. On the other hand, Coase would argue that if districts can bargain without transaction cost, there is no need for a direct federal intervention. From the more modern viewpoint of implementation theory, if such interdistrict contracts can be enforced, the Coasian argument can be reversed: any feasible mechanism can be implemented by a federal authority. In particular, a neutral central planner could just replicate the properties of decentralisation by running local offices and eventually remedy coordination problems that are not satisfactorily handled at the local level. Hence, the theoretical literature leaves the question of the vertical allocation of power unanswered. Moreover, it is difficult to understand how rigidity and coordination failures should emerge as organisational patterns[5]. In order to get some insights on the nature and comparative advantages of centralisation and decentralisation, one has to give a precise account of their respective departure from those conjectural solutions. The informational and constitutional constraints faced by each level of governments have to be taken into account.

Under centralisation, in our model, a self interested federal planner will choose a uniform policy equal to its autharky bliss point. Hence, uniformity could appear as a result of a lack of commitment in a centralised representative democracy. Some authors (e.g. Hayek 1945) have questioned the knowledge of each level of governments. The common wisdom is that local jurisdictions have an informational advantage on the central government which has access only to some average characteristics of its constituents. If it is too costly to extract and process those decentralised informations, even a benevolent central authority may not do better than a uniform policy. It

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[5]See for instance Crémer, Estache and Seabright 1996 and Caillaud, Jullien and Picard 1996 for a more detailled discussion.

has been also argued that the central authority may be constitutionally compelled to impose the same rule to all districts, for instance in the legislative sphere. The common idea underlying those perspectives is that the main failure of centralisation is its inability to take into account local specificities. Hence, the uniformity constraint can be thought of as a proxy for the cost of centralisation.

Under decentralisation, if transaction costs are sufficiently high as it is often the case in the political arena — for instance because policies are hardly verifiable or because there is no neutral federal court to enforce interdistrict contracts — political competition and opportunistic behavior from local representatives will typically result in an inefficient Nash equilibrium. Similarly, the inability to secure cooperation is a reasonable proxy for the cost of decentralisation.

In full generality, the adequate research strategy would be to endogenize the behavior of local and central jurisdictions. Recently, several attempts have been made in this direction. Among others, Lockwood 2000 and Besley and Coate 2003 take a political economy approach while Seabright 1996 and Loeper 2005 use the tools of contract theory. Loeper 2005 considers the same preference profile as described above and supposes that the district types are not known from the central planner. It is shown that the range of federal mechanisms which are neutral and group strategyproof is necessarily restricted to uniform policies. However, those issues are beyond the scope of the current paper. The question we want to answer here is whether Oates's conclusions are still valid in a model with the same constitutional and behavioral hypotheses but with a structure of conflict of interest notably different of the one studied in the literature on fiscal or environmental federalism.

2.3 Centralised and Decentralised Equilibria

2.3.1 Centralisation

Under centralisation, the confederation has to choose a common policy x^c. Most of our results do not depend on the particular common policy which is chosen. In those instances, x^c will simply refer to any uniform policy. In some sections, we shall perform comparative statics with respect to the preferences parameters, and hence consider the uniform policy as a function of the profile of voters types $T \equiv (t_{i,d})_{(i,d) \in I}$ and the externality matrix β. This function $x^c(T, \beta)$ will be refered to as the centralised mechanism. To obtain our

results, we shall only assume that the centralised mechanism derives from a political process which is neutral with respect to the policies. Therefore, it is a function of the ordinal preferences of the voters only. We have the following characterisation, whose proof is omitted for the sake of brevity[6]:

Proposition 1 *A centralised mechanism x^c is neutral with respect to the the policies if and only if*
i) x^c is independant of the externality matrix,
ii) $\forall \alpha \in \Re,\ x^c(\alpha T) = \alpha x^c(T)$,
iii) $\forall \alpha \in \Re,\ \Psi(T + \alpha(1,..,1)) = \Psi(T) + \alpha(1,..,1)$,
where $(1,..,1)$ is a uniform profile of type equal to 1.

For instance, if the federal elections are open and under the control of direct majority rule among all citizens of the confederation, then the median of all types, when it exists, is the only unbeatable policy and it satisfies the conditions of proposition (1):

$$x^c(T) = median(T).(1,..,1).\tag{2}$$

If it is chosen in two steps by indirect majority rule, i.e. simple majority among district representatives, the latter being chosen by local simple majority rule, the federal mechanism is given by:

$$x^c = median(t).(1,..,1),\tag{3}$$

provided that there is an odd number of districts.

2.3.2   Decentralisation

When decentralised, policies are under the control of local jurisdictions. We suppose that their behavior is driven by open political competition under simple local majority rule. Hence, a policy vector is a decentralised equilibrium if for each districts, there is no deviation of the local policy that would be strictly preferred by a local majority.

Definition 1 *A policy vector x is a decentralised equilibrium if for all d, x_d is a Condorcet winner in district d taking the policies of the other districts x_{-d} as given.*

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[6]The proof can be easily adapted from the proof of the corresponding proposition in Loeper 2005.

The preferences of the majority within district d over the whole set of alternatives are denoted $\succeq_d$ and are defined in the following way:

$$x \succeq_d y \Leftrightarrow \# \left\{ i \in I_d \text{ s.t. } U_{i,d}(x) > U_{i,d}(y) \right\} \geq \# \left\{ i \in I_d \text{ s.t. } U_{i,d}(x) < U_{i,d}(y) \right\}$$

for all x and y in $\Re^D$. Now observe that within each district, individual preferences differ only through the term $t_{i,d}$. As it appears in a linear way in our cardinal utility representation in (1), the profile of preferences belongs to the class of intermediate preferences studied by Grandmont (1978). Therefore, $\succeq_d$ are exactly the preferences of the local median type (t_d, d). In the sequel, with a slight abuse of notation, we shall refer to t_d as the type of district d. In particular, taking the policies of the other districts x_{-d} as given, the marginal majority preferences in district d over the local policy x_d are also the marginal preferences of the local median voter. This shows that a policy vector x is a decentralised equilibrium if and only if it is a Nash equilibrium of a simplified game where local median voters control their respective policy.

Proposition 2 *There exists a unique decentralised equilibrium.*

Proof. Observe that our preferences profile exhibits strategic complementarities since $\frac{\partial^2 U_d(x)}{\partial x_d \partial x_\delta} = 2\beta_{d,\delta} \geq 0$. Hence, the game between local median voters is supermodular. It is well known that in such games, a pure strategy Nash equilibrium exists[7]. Since utility functions are concave, the Nash equilibria satisfy the first order conditions for the local median voters

$$x_d^{dec} - t_d + \sum_{\delta \neq d} \beta_{d,\delta}(x_d^{dec} - x_\delta^{dec}) = 0, \tag{4}$$

for $d = 1..D$. As this linear system has a solution for all vector of types, it is non singular and can be inverted. Therefore the solution is unique. ∎

Notice that as the game between local median types is supermodular with a unique pure strategy Nash equilibrium, it satisfies some more properties that make it a robust prediction in case of non cooperative behavior under mild rationality and informational assumptions[8].

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[7] The regularity conditions are clearly satisfied. We just have to restrict strategies to a bounded set, for instance $[\min t_d; \max t_d]$, and then show that an equilibrium in $[\min t_d; \max t_d]^D$ is an equilibrium in $\Re^D$.

[8] For further development, see Milgrom and Roberts, 1990.

3   Paretian Analysis

Heterogeneity of preferences both within and between districts gives rise to two kinds of conflict of interests. In order to focus on the conflict of interest between district which is the cornerstone of federalism, we introduce in the first subsection the notion of interdistrict efficiency which is based on local majority. It allows us to perform the welfare analysis essentially as if types would be identical within districts. We show that the decentralised equilibrium is generically not interdistrict efficient. On the contrary, there exists interdistrict efficient centralised mechanism. We then discuss under which condition a uniform policy could be more interdistrict efficient than the decentralised equilibrium and show that the cost of centralisation will outweigh its benefits for districts with exterme preferences.

3.1   Interdistrict Efficiency

Traditional economic reasoning suggests that the decentralised voting equilibrium is suboptimal since pivotal voters only face the local cost of externalities and don't take into account the cost for the rest of the confederation. Nevertheless, one can show that if the distribution of types is sufficiently spread in each district, any policy is optimal in the usual Pareto sense.

Proposition 3 *If the distribution of types has full support in each district, any policy is Pareto efficient.*

   Proof. If we consider only one individual (i^*, d) for each district, the solution of the following utilitarian program

$$\max_{x \in \Re^D} \sum_{1 \leq d \leq D} \left\{ \left[-(x_d - t_{i^*, d})^2 \right] + \left[-\sum_{\delta \neq d} \beta_{d,\delta}(x_d - x_\delta)^2 \right] \right\},$$

is Pareto-optimal for those D individuals, and so for the whole confederation since we cannot change the policy without hurting one of them. The maximand being strictly concave, the unique solution is given by the first-order conditions

$$(x_d - t_d^*) + \sum_{\delta \neq d} \left(\beta_{d,\delta} + \beta_{\delta,d} \right) (x_d - x_\delta) = 0,$$

for all d. As the distribution has full support in each district, for all policy vector x we can choose our D individuals such that

$$t_{i^*,d} = x_d + \sum_{\delta \neq d} \left(\beta_{d,\delta} + \beta_{\delta,d} \right) \times (x_d - x_\delta).$$

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Pareto domination is too stringent to disentangle interdistrict externality costs from the effect of intradistrict heterogeneity. In order to focus on interdistrict rather than intradistrict conflict of interests, we replace Pareto domination by a weaker criterion which requires only a local majority of people to be strictly better off in all districts.

Definition 2 *A policy x interdistrict dominates a policy y if x is strictly preferred to y by a majority of voters in all districts.*

As local median types are the representative voters in their respective districts, a policy is interdistrict efficient if and only if it is Pareto optimal for local median types.

Proposition 4 *Decentralised voting equilibria are interdistrict efficient if and only if local median types are identical.*

Proof. Let x be a decentralised equilibrium. If it is interdistrict efficient it is Pareto-optimal for local median types. Therefore, there exists a vector of district weights $(\lambda_d)_{d=1..D}$ such that the first order conditions of the utilitarian program among local median voters are satisfied:

$$\lambda_d \left(x_d - t_d \right) + \sum_{\delta \neq d} \left(\lambda_d \beta_{d,\delta} + \lambda_\delta \beta_{\delta,d} \right) (x_d - x_\delta) = 0, \qquad (5)$$

for all d. Substracting the equilibrium condition (4), we get:

$$\sum_{\delta \neq d} \lambda_\delta \beta_{\delta,d}(x_d - x_\delta) = 0.$$

Let $x_{\underline{d}}$ be the highest policy. For all $\delta \neq \underline{d}$, $\lambda_\delta \beta_{\delta,\underline{d}}(x_{\underline{d}} - x_\delta) \geq 0$. As those terms sum up to 0, necessarily all of them are null. This implies that for all $\delta \neq \underline{d}$, $\lambda_\delta = 0$ or $x_\delta = x_{\underline{d}}$. For all d such that $\lambda_\delta = 0$, $x_d = x_{\underline{d}}$ satisfy the D first order conditions in (5). Therefore, the decentralised equilibrium is

uniform. From the Nash conditions in (4), necessarily the district types are all equal to $x_{\underline{d}}$. Reciprocally, if district types are uniform, the decentralised equilibrium is uniform as well and from (5) it is interdistrict efficient. ∎

Hence, the interdistrict efficiency criterion captures the cost of decentralisation and the economic intuition is confirmed, which leaves room for improvement by a central intervention. Moreover, it is easy to see that the gap between local and federal cost results in an excessive heterogeneity of local policies and one could wonder whether a well chosen uniform policy could leave all districts better-off.

3.2 Participation Constraints

Contrary to the decentralised equilibrium, a uniform policy can be interdistrict efficient, for instance if it is chosen by the indirect majority rule previously defined in (3). Indeed, it is equivalent to the dictatorship of the representative voter of the median district. However, one cannot simply conclude that the criterion of interdistrict efficiency supports centralisation. It turns out that centralisation never interdistrict dominates decentralisation. For the sake of clarity, we first give a compact formulation of the difference between the utility level achieved under centralisation and decentralisation for local median types:

Lemma 1 *For a given preference profile* (β, t)*, let* x^{dec} *denote the decentralised equilibrium vector,* x^c *any uniform policy,* U_d^{dec} *and* U_d^c *the level of utility achieved for the local median type in district d respectively under decentralisation and under the uniform policy* x^c*, then:*

$$U_d^{dec} - U_d^c = \left(x_d^{dec} - x^c\right)^2 + \sum_\delta \beta_{d,\delta} \left[\left(x_d^{dec} - x^c\right)^2 - \left(x_\delta^{dec} - x^c\right)^2\right].$$

Proof. From equation 4, we have

$$x_d^{dec} - t_d = -\sum_\delta \beta_{d,\delta} \left(x_d - x_\delta\right).$$

Decomposing $x^c - t_d$ in $\left(x^c - x_d^{dec}\right) + \left(x_d^{dec} - t_d\right)$, we can write:

$$-U_d^c = (x^c - t_d)^2 = \left(x^c - x_d^{dec}\right)^2 + \left(x_d^{dec} - t_d\right)^2 - 2\left(x^c - x_d^{dec}\right)\sum_\delta \beta_{d,\delta}\left(x_d^{dec} - x_\delta^{dec}\right).$$

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Adding $U_d^{dec} = -\left(x_d^{dec} - t_d\right)^2 - \sum_\delta \beta_{d,\delta} \left(x_d^{dec} - x_\delta^{dec}\right)^2$, we obtain

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\begin{aligned}
U_d^{dec} - U_d^c &= \left(x_d^{dec} - x^c\right)^2 + \sum_\delta \beta_{d,\delta} \left(x_d^{dec} - x_\delta^{dec}\right) \left(x_d^{dec} + x_\delta^{dec} - 2x^c\right), \\
&= \left(x_d^{dec} - x^c\right)^2 + \sum_\delta \beta_{d,\delta} \left[\left(x_d^{dec} - x^c\right)^2 - \left(x_\delta^{dec} - x^c\right)^2\right].
\end{aligned}
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We are now ready to prove our statement:

Proposition 5 *The decentralised equilibrium is never interdistrict dominated by a uniform policy. Whenever district types are not identical, there is a local majority of citizens who strictly prefer decentralisation in the district whose decentralised policy is the farthest from the centralised policy.*

Proof. Let $\overline{d}$ be the maximand of $(x_d - x^c)^2$, then for all d, $(x_{\overline{d}} - x^c)^2 - (x_d - x^c)^2 \geq 0$. Using lemma 1, $U_{\overline{d}}^{dec} \geq U_{\overline{d}}^c$, with a strict inequality whenever $(x_{\overline{d}} - x^c)^2 > 0$, which is true whenever district types are not identical. ∎

Proposition 5 states that as soon as district preferences are not all the same, the centralised confederation will not be stable since a local majority in some extreme states will strictly prefer to secede even if they anticipate that their unilateral deviation will break the whole confederation. Observe that contrary to our model, in most paper on fiscal competition or environmental federalism, the stability of the grand confederation under a uniform rule can be guaranteed if preferences are sufficiently homogeneous and/or spillovers sufficiently large[9].

3.3 The Fundamental Trade-off of Federalism

Finally, both decentralisation and centralisation cannot be considered as satisfactory unless local preferences are identical. The former exhibits inefficiencies due to the gap between local and federal cost. The latter avoid externalities through uniformity but potential efficiency gains are never big enough to compensate extreme districts. We end up with a familiar trade-off between the satisfaction of local needs and the internalization of externalities. A natural question is then which one of those failures will be more severe in social terms. As it has been discussed, centralisation and decentralisation

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[9]See Piketty 1996 or Alesina, Angeloni and Etro, 2001 among others.

cannot be ranked unanimously. To shed some light on the determinants of this trade-off, we have to use a more discriminatory notion of social welfare than interdistrict efficiency.

Before going into the details of the formal analysis, we might observe that the cost of decentralisation, i.e. non cooperative behavior, is likely to increase with the severity of externalities, i.e. when the entries of the matrix β increase. Similarly, the cost of centralisation, i.e. policy uniformity, is likely to increase with the heterogeneity of district types. Hence, one might conjecture with Oates that the benefits of centralisation outweigh its costs when externalities are sufficiently severe and the heterogeneity of types is sufficiently small. However, we will see that Oates's theorem has to be significantly revisited in our model.

4 Federal Surplus

4.1 The Benthamite Criterion

The relative merits of both regimes clearly depends on the way we define the social welfare. From a welfarist point of view, it can be resumed in an increasing function of the utility levels of the citizens : $W\left((U_{i,d})_{i,d\in I}\right)$. In this section, we will assume that all districts have the same population size. If we impose district anonymity[10] and consistency with interdistrict domination, W must be a symmetric function of the utility levels of the local median types only. Which particular function W to choose depends on the relative weight we give to efficiency versus redistributive concerns. In this section we focus on efficiency.

Suppose that utility is transferable between districts, say through monetary transfers[11] and that interdistrict transfers are distributed evenly within districts. If the population size is the same in all districts, then whatever the social welfare function W, allocative interdistrict efficiency is equivalent to the Benthamite criterion among local median types. More precisely for a given preference profile (β, t), modulo interdistrict transfers, a policy vector x interdistrict dominates a policy vector y if and only if $B(x) > B(y)$ where

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[10]Notice that individual utility levels under our quadratic representation are normalized through the idiosynchratic term, which allow interpersonnal ordinal comparison.

[11]More precisely, we assume that utils are transferable under the quadratic representation in (1).

B is the utilitarian social welfare function:

$$B\left(x\right) \equiv \sum_{d=1}^{D} U_d(t_d, x).$$

The question to be answered is then whether the centralised or the decentralised regime achieves the higher Benthamite surplus.

4.2   A Decentralisation Theorem

Let β_d^S and β_d^I be the sum of the coefficients of external effects respectively *Suffered* and *Incurred* by district d:

$$\begin{aligned} \beta_d^S &\equiv \sum_{\delta} \beta_{d,\delta}, \\ \beta_d^I &\equiv \sum_{\delta} \beta_{\delta,d}. \end{aligned}$$

The next lemma expresses the differential level of Benthamite welfare achieved under decentralisation versus centralisation as a function of β^S, β^I and of the decentralised equilibrium policies.

Lemma 2 *Let x^{dec} be the decentralised equilibrium and x^c the uniform policy vector chosen under centralisation, then*

$$B\left(x^{dec}\right) - B\left(x^c\right) = \sum_{d=1}^{D} \left(1 + \beta_d^S - \beta_d^I\right) \left(x_d^{dec} - x^c\right)^2.$$

   Proof. From lemma 1

$$U_d\left(x^{dec}\right) - U_d\left(x^c\right) = \left(x_d^{dec} - x^c\right)^2 + \sum_{\delta} \beta_{d,\delta} \left[\left(x_d^{dec} - x^c\right)^2 - \left(x_\delta^{dec} - x^c\right)^2\right].$$

$$(6)$$

Now observe that

$$\sum_d \sum_\delta \frac{\beta_{d,\delta} + \beta_{\delta,d}}{2} \left[\left(x_d^{dec} - x^c\right)^2 - \left(x_\delta^{dec} - x^c\right)^2\right] = 0, \qquad (7)$$

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and that

$$\sum_d \sum_\delta \frac{\beta_{d,\delta} - \beta_{\delta,d}}{2} \left[\left(x_d^{dec} - x^c \right)^2 - \left(x_\delta^{dec} - x^c \right)^2 \right]$$

$$= \sum_d \left(\sum_\delta \left(\beta_{d,\delta} - \beta_{\delta,d} \right) \right) \left(x_d^{dec} - x^c \right)^2. \quad (8)$$

Summing (6) over all districts and using (7) and (8), we get

$$B \left(x^{dec} \right) - B \left(x^c \right) = \sum_{d=1}^{D} \left[\left(1 + \sum_{\delta=1}^{D} \left(\beta_{d,\delta} - \beta_{\delta,d} \right) \right) \left(x_d^{dec} - x^c \right)^2 \right].$$

∎

4.2.1 The role of heterogeneity

Let us first derive some comparative statics with respect to the profile of district types. To focus on the impact of the heterogeneity of preferences, we compare profile of types that are homothetic mean preserving spread transformation of each other. Formally, we say that a profile of district types t' is an homothetic mean preserving transformation of a profile t if:

$$\exists a \in \Re \text{ such that } t' = at + (1 - a) \, \overline{t}. \, (1, .., 1).$$

The first conclusion that can be deduced from lemma 2 is that contrary to the first part of Oates's theorem which states that more heterogeneity in preferences favors decentralisation, the spread of district types is not a decisive parameter in our model. This is shown in the following proposition.

Proposition 6 *The Benthamite ranking of the decentralised equilibrium and any neutral centralised mechanism[12] is invariant by an homothetic mean preserving transformation of the distribution of types.*

Proof. Let x^c be any neutral centralised mechanism, and let t and t' be two profile of district types such that there exists $a \in \Re$ such that $t' = at + (1 - a) \, \overline{t}. \, (1, .., 1)$. From (4), it can be seen that

$$x^{dec} \left(t' \right) = a * x^{dec} \left(t \right) + (1 - a) \, \overline{t}. \, (1, .., 1).$$

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[12]Observe that the Benthamite optimal uniform policy is indeed a neutral mechanism.

By proposition (1), the same identity holds for any neutral mechanism x^c. Hence for any real number a and any uniform vector b:

$$\left(x_d^{dec}\left(t'\right) - x^c\left(t'\right)\right)^2 = a^2 \left(x_d^{dec}\left(t\right) - x^c\left(t\right)\right)^2 .$$

Substituting the latter equation in lemma 2, we have:

$$B\left(x^{dec}\left(t'\right)\right) - B\left(x^c\left(t'\right)\right) = a^2 \left[B\left(x^{dec}\left(t\right)\right) - B\left(\bar{t}\right)\right] ,$$

which yields the desired conclusion. ■

In particular case of two districts, the difference in Benthamite welfare achieved under decentralisation and under the optimal Benthamite uniform policy is given by

$$B\left(x_1^{dec}, x_2^{dec}\right) - B\left(\bar{t}\right) = \frac{\left(1 - \left(\beta_{1,2} - \beta_{2,1}\right)^2\right)}{2\left(1 + \beta_{1,2} + \beta_{2,1}\right)^2}\left(t_1 - t_2\right)^2 . \tag{9}$$

It can be seen that its sign does not depend on the profile of district type.

4.2.2   The role of external effects

The last discussion sugests that the parameters affecting the comparative advantages of the two regimes are more likely to be found in the externality matrix β. In the case of two districts, equation (9) shows that the Benthamite ranking of decentralisation and optimal centralisation depends only on the antisymmetric part[13] of the externality matrix $\left(\beta_{1,2} - \beta_{2,1}\right)$. More precisely, decentralisation is Benthamite preferred to any uniform policy if and only if its absolute value $\left|\beta_{1,2} - \beta_{2,1}\right|$ is smaller than the weight of the idiosyncratic effect - normalized at 1 in our specification in (1). The next proposition generalizes this idea for more than two districts and shows that decentralisation Benthamite dominates any uniform rule for all distribution of types under similar symmetry conditions between the vectors β^S and β^I.

Proposition 7 *Decentralisation achieves a higher Benthamite welfare than any uniform policy for all distribution of types if and only if*

$$1 + \beta_d^S - \beta_d^I \geq 0,$$

for all d.

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[13]The symmetric and antisymmetric part of a square matrix β are defined by $\frac{\beta + \beta^t}{2}$ and $\frac{\beta - \beta^t}{2}$ respectively.

Proof. The sufficient part is a straightforward consequence lemma 2. For the necessary part, suppose that there is one district δ for which $1 + \beta_\delta^S - \beta_\delta^I < 0$. Remember that for all policy vector x and for all externality matrix β, it is possible to find a vector of district type $(t_d(x))_{d=1..D}$ such that x is the corresponding decentralised equilibrium. This can be done simply by inverting the linear system given by (4).

Now it is clear that for a given x^c and x_{-d}, it is possible to choose x_d sufficiently extreme so that $\sum_{d=1}^D \left(1 + \beta_d^S - \beta_d^I\right)(x_d - x^c)^2$ is negative. Hence, for the corresponding profile of district type, the uniform policy x^c achieves a higher Benthamite welfare than the decentralised equilibrium. A fortiori, so does the optimal uniform one. ∎

As $\sum_{d=1}^D \beta_d^S = \sum_{d=1}^D \beta_d^I$, the conditions of proposition 7 implies that each term $\beta_d^S - \beta_d^I$ should not be too big in absolute terms compared to the weight of the idiosyncratic effect, i.e. that for all districts, the difference between external costs incurred and suffered by each districts should not be too large. In terms of distribution of externalities, this condition is satisfied in particular if the matrix β is symmetric, which means that externalities are reciprocal, or if β is a magical square[14], which roughly means that at the margin, each district suffers and incurs the same amount of external costs.

Notice that contrary to the second part of Oates's theorem which states that centralisation should prevail if the cross border externalities are sufficiently severe, if the matrix β is symmetric or if it is a magical square, decentralisation Benthamite dominates centralisation however big are the external effects. The intuition behind this result is that when external effects are reciprocal, districts internalize half of the externality they impose to their neighbors under decentralisation. In terms of size of externalities, this condition is clearly satisfied if β is small enough independently of any symmetry conditions but our conclusions still differ from Oates's as they do not depend on the heterogeneity of preferences.

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[14] A matrix is a magical square if the sum of its entries for each ligne and each column is the same. With our notation, for all d and δ, $\beta_d^S = \beta_\delta^S$ and $\beta_d^I = \beta_\delta^I$.

5 Redistribution

Let us now turn our attention to the issue of inequality and redistribution[15]. The relative redistributive performance of centralisation versus decentralisation depends on the particular social criterion we have in mind. However, simple informal considerations allow to understand that centralisation can generally not reduce the inequalities arising under decentralisation.

Assume that central districts — loosely speaking, districts whose type is in the center of the distribution— are better off under decentralisation than extreme ones — districts with a right extreme or left extreme type. This hypothesis is reasonable since coordination externalities increase with the distance between the home policy and the other districts's policies. A uniform policy, which will typically be chosen in the centre of the distribution of types, is likely to exacerbate the inequalities between the centre and the extremes, at least for one of the two extremes as suggested by proposition (5).

More formally, we consider the Pigou-Dalton redistributive criterion among local median types:

Definition 3 *A vector of utility levels $(U_d)_{d=1..D}$ is more Pigou-Dalton redistributive than another one $(V_d)_{d=1..D}$ whenever U can be obtained from V by a sequence of progressive transfers.*

5.1 The role of heterogeneity

Similarly as in the preceding section, to derive comparative statics with respect to the heterogeneity of preferences, we compare profile of types that are homothetic mean preserving transformation of each other. As with the Benthamite criterion, the spread of preferences does not play a decisive role in the redistributive performance of the two decision process.

Proposition 8 *The Pigou-Dalton ranking of the decentralised equilibrium and any neutral centralised mechanism[16] is invariant by an homothetic mean preserving transformation of the distribution of types.*

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[15]Remember that individual utility levels under our quadratic representation are ordinally comparable. In particular it is possible to compare the welfare of local median voters..

[16]Observe that the Benthamite optimal uniform policy is indeed a neutral mechanism.

Proof. Let x^c be any neutral centralised mechanism, and let t and t' be two profile of district types such that there exists $a \in \Re$ such that $t' = at + \left((1-a)\,\bar{t} \right)_{d=1..D}$. Similarly as in the proof of proposition (6) one can show that

$$U_d \left(x^{dec} \left(t' \right) \right) - U_d \left(x^c \left(t' \right) \right) = a^2 \left[U_d \left(x^{dec} \left(t \right) \right) - U_d \left(x^c \left(t \right) \right) \right].$$

Hence if $U_d \left(x^{dec} \left(t \right) \right)$ can be obtained from $U_d \left(x^c \left(t \right) \right)$ by a sequence of transfers, then $U_d \left(x^{dec} \left(t' \right) \right)$ can be obtained from $U_d \left(x^c \left(t' \right) \right)$ with the same transfers multiplied by a^2. Therefore, the former transfers are regressive if and only if the latter are regressive as well. ∎

5.2 The role of external effects

In this subsection, we shall states formally the intuition previously discussed that centralisation cannot redistribute from the centre to the extremes. Consider first the case of uniform externalities, i.e. $\beta_{d,\delta} \equiv \beta \in \Re^+$ for all d, δ. Simple algebra yields

$$U_d \left(x^{dec} \left(t \right) \right) = - \frac{\beta \left(t_d - \bar{t} \right)^2 + \left(\beta + \beta^2 \right) \sigma_t^2}{\left(1 + \beta \right)^2},$$

where σ_t^2 is the variance of district types. The optimal Benthamite uniform rule $\left(\bar{t}, .., \bar{t} \right)$, which is Pigou-Dalton optimal as well, yields the payoffs

$$U_d \left(\bar{t}, .., \bar{t} \right) = - \left(t_d - \bar{t} \right)^2.$$

Simple algebra shows that the vector of utility levels $U \left(\bar{t}, .., \bar{t} \right)$ is a mean decreasing homothetic spread of $U \left(x^{dec} \left(t \right) \right)$, and thus $x^{dec} \left(t \right)$ is Pigou-Dalton preferred to $\left(\bar{t}, .., \bar{t} \right)$. If, furhtermore, the distribution of type is symmetric, $\left(\bar{t}, .., \bar{t} \right)$ is the only optimal Pigou-Dalton uniform rule, and by transitivity, the decentralised equilibrium is Pigou-Dalton preferred to any uniform policy. This result can be generalized to the case of reciprocal externalities under a condition that roughly means that the uniform policy has a central location and that at the decentralised equilibrium, districts with extreme policies are indeed worse off than districts with central policies. Formally:

Definition 4 *For a given distribution of type and externality matrix, a uniform policy x^c is order preserving if*

$$U_d^{dec} \geq U_\delta^{dec} \Leftrightarrow \left(x_d - x^c \right)^2 \leq \left(x_\delta - x^c \right)^2.$$

Observe that if externalities are uniform and the distribution of types is symmetric, the optimal Pigou Dalton uniform policy is indeed order preserving.

Proposition 9 *If the externality matrix is symmetric, decentralisation is Pigou Dalton preferred to any order preserving uniform policy.*

Proof. From lemma 1, we have:

$$U_d^c - U_d^{dec} = -\left(x_d - x^c\right)^2 - \sum_\delta \beta_{d,\delta} \left[\left(x_d - x^c\right)^2 - \left(x_\delta - x^c\right)^2\right].$$

If β is symmetric, one can see $T_{d,\delta} \equiv -\beta_{d,\delta}\left[\left(x_d - x^c\right)^2 - \left(x_\delta - x^c\right)^2\right]$ as a transfer from district d to district δ since $T_{d,\delta} + T_{\delta,d} = 0$. Starting from a decentralised equilibrium, this transfer increases inequalities if x^c is order preserving. Centralisation is then equivalent to a sequence of regressive transfers between pairs of districts, and a negative transfers to all districts $T_d \equiv -\left(x_d - x^c\right)^2$. Therefore, the uniform policy x^c cannot be Pigou Dalton preferred to the decentralised equilibrium. ■

We conclude that the redistributive potential of centralisation is rather the exception than the norm and can be justified only in the presence of large asymmetries in external effects.

6 Conclusion

In this paper, we have studied the welfare property of unitarian centralisation versus non cooperative decentralisation in the presence of coordination externalities along with disjunct preferences. The comparison between centralisation and decentralisation highlights a trade off between the internalization of externalities and the match of local needs which is familiar in fiscal federalism. However, it turns out that contrary to the latter case, whether we care about efficiency or redistribution, the relevant comparative statics of the comparison of the two regimes are not to be found in the heterogeneity of preferences nor in the severity of externalities, but in their asymmetries. Our results suggest that if coordination costs are reciprocal, the preferences frustration generated by centralisation may be socially more severe than the coordination costs arising under decentralisation. Under those conditions, even the weakest notion of subsidiarity seems to be violated. Moreover, our

preferences patterns focus on coordination failure and do not take into account the potential benefits of independent local governments in terms of cultural diversity and innovation. Finally, the welfarist approach do not address two other fundamental dimensions of the federalism debate, namely political participation and minority protection which are likely to be more adequately handled at the local level.

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