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Diskussionsbeiträge

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**Income Redistribution in an Economic Union:  
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**Martin Kolmar**

**Serie I – Nr. 317**

**April 2002**

# Income Redistribution in an Economic Union: Does Asymmetric Information Legitimize Centralization?\*

Martin Kolmar<sup>†</sup>

April 15, 2002

## Abstract

In this paper the role of information asymmetries between regions and a centralized authority is analyzed. In a model with inter-regional externalities due to capital mobility and a source-based tax instrument, we first derive conditions for which the optimum can be implemented by an adequately designed institution even with decentralized information about preferences for redistribution. Second we demonstrate that social-policy does not have to be centralized in order to implement the optimum. Decentralization of social policies is compatible with efficiency even when source-based taxes have to be used if decentralized authorities can rely on the enforcement of bilateral contracts.

*Keywords:* Fiscal Federalism, Asymmetric Information, Decentralization

*JEL classifications:* H23, F15, D31

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# 1 Introduction

During the last couple of years, the theoretical literature on fiscal federalism has focused attention on the role of information asymmetries in reaching first-best allocations and the optimal vertical allocation of political responsibilities between regions and a centralized authority. See for example Bordignon/Manasse/Tabellini (1999), Bucovetsky/Marchand/Pestieau (1999), Crémer/Pestieau (1996), Dhillon/Perroni/Scharf (1999), Lockwood (1999), and Raff/Wilson (1997). The process of market integration, so the story goes, makes it difficult, if not impossible, to achieve regional redistributive objectives or to supply regional public goods efficiently. See for example Sinn (1990), Wellisch (1996), and Wildasin (1991,94). This problem of tax competition is sometimes analyzed in connection with the problem of inter-regional redistribution in the presence of inter-regional inequality aversion which might be due to non-diversified aggregate regional risks or general concerns about equality between regions.<sup>1</sup> The first problem requires some kind of inter-regional redistribution in order to internalize the externalities. To be able to calculate these payments, information about regional preferences and/or regional technologies has to be symmetric. It is argued that this information is in general private; thus, information asymmetries make it impossible to directly apply first-best transfer schemes. The same argument holds for the case of inter-regional inequality aversion: in order to calculate efficient premiums, the insurance 'company' needs information about regional risks that is in general private information. Efficient insurance implies ex-post redistribution between regions.

Following this argument, the above mentioned papers have analyzed the role of information asymmetries for the set of implementable allocations and the optimal structure of inter-regional transfers. Most papers conclude that the full-information optimum can no longer be implemented in presence of information asymmetries. Furthermore, some degree of centralization of responsibilities for redistributive policies might be required in order to reach at least a second-, 'third', or 'fourth'-best solution.

In this paper we use a two-step approach to determine the relevant optimum and the optimal vertical allocation of political responsibilities. First we characterize conditions under which information asymmetries allow or prevent to attain the relevant full-information optimum. Second we look for the optimal hierarchical allocation of responsibilities between regional and centralized authorities that implements the optimal allocation.

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<sup>1</sup>This is done in Cornes/Silva (2000), Crémer/Pestieau (1996) and Raff/Wilson (1997). Bordignon/Manasse/Tabellini (1999) and Lockwood (1999) restrict attention to the case of inter-regional redistribution.

In order to do so we restrict attention to the problem of tax competition in a model with capital mobility. We assume that regions do not have any inter-regional insurance motives. As a consequence, there is no motive to pay inter-regional (insurance) transfers in the absence of inter-regional externalities. There are, however, inter-regional externalities which result from a source-based tax on capital. Thus, with integrated markets, mobile factors can avoid redistribution by emigrating from high-tax regions and immigrating to low-tax regions. The only task for inter-regional (tax-competition) transfers in this paper is to internalize these externalities. In models with inter-regional inequality aversion, however, transfers would be positive even in the absence of inter-regional externalities due to the insurance motive.

Without inter-regional inequality aversion it turns out that the full-information optimum can be implemented in presence of information asymmetries if either the gains from cooperation are large enough to guarantee voluntary participation at every stage of the game or a centralized government has sufficient coercive power to enforce multilateral ex-ante contracts between regions. In order to establish this result we define an operational concept of coercive power that is derived from the regional participation constraints.<sup>2</sup>

This observation, however, defines not more than the relevant benchmark for the evaluation of institutions. It is neither an argument in favor of centralization or in favor of decentralization. Consequently, the second aim of this paper is to look for institutions that are able to support the optimum. The question of implementability of allocations for a given environment is qualitatively different from the question of which institutions support the optimal allocation.

In order to answer the question of the optimal vertical allocation of policies it is insufficient to distinguish only between centralization and decentralization. In its most common meaning, centralization and decentralization relate to the redistributive policies themselves with no further specification of supra-national legal rules that apply for both, centralization and decentralization. However, centralization in this sense implies that the centralized authority is enabled to punish deviations from its policies. Hence, "centralization" means a specific system of supra-national legal rules that enables the centralized authority to execute compulsion without restrictions. The precise meaning of the term decentralization is by far less evident. It may either refer to a situation of "supra-national anarchy" where no bi- or multilateral contracts are enforced or to a situation of credible supra-national rules where national authorities can rely on the enforcement of contractual obligations. It is intuitive that the precise meaning of the term decentralization matters for a comparison between decentralization and centralization. Hence, the relevant question for the optimal hierarchical

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<sup>2</sup>The importance of participation constraints has also been analyzed by Cornes/Silva (2000).

structure of economic responsibilities is not “centralization or decentralization?” but “centralization of what?”. In this paper we will distinguish between four different degrees of centralization.

- (CD) The system is *completely decentralized* if redistributive policies are administered by the national authorities and no supra-national authority exists (supra-national anarchy).
- (PD) The system is *partly decentralized* if redistributive policies are administered by national authorities and a supra-national authority exists that credibly enforces voluntary bi- or multilateral contracts between the national authorities.
- (PC) The system is *partly centralized* if redistributive policies are administered by national authorities and a supra-national authority exists that has the right to use compulsory incentive payments (centralized grants) to internalize the externality.
- (CC) The system is *completely centralized* if redistributive policies are administered by a supra-national authority.

All four institutional structures can be ranked with respect to the richness of supra-national rules necessary to support the degree of centralization. Whereas in (CD), no such rule exists, the central authority acts as a “night-watchman” in (PD) without any responsibility for policies. In order to serve this purpose it must be authorized to punish deviations from bi- and multilateral contracts. In addition to this, the central authority has the right to tax and transfer income in (PC). Nevertheless, it still has no right to redistribute income within a region. This last right is given to the central authority only in (CC).

As we have argued above, implementability can be checked by the use of the direct-revelation principle. A direct mechanism can be interpreted as a simple central-planner institution corresponding to (CC). Hence, models for which the direct-revelation principle applies are biased towards centralization in the following sense: decentralized institutions can never do better than this central-planner institution. From this simple observation, however, it does not follow directly that redistributive policies need to be centralized. First, direct mechanisms can almost never be observed in reality. Second, if a direct mechanism exists, there might be several other – indirect – mechanisms that are strategically equivalent. Hence, we have to identify mechanisms that can be interpreted as CD, PD, or PC institutions.

The two major results of the paper are: (i) the extend of coercive power of a centralized authority is crucial for the implementability of the optimum, (ii) there exists a partially

decentralized (PD) allocation of political responsibilities that implements the relevant optimum. We can therefore conclude that asymmetric information in tax-competition models does not imply the delegation of political responsibilities to a centralized authority for reasons of efficiency. Its economic role is to guarantee that mutual obligations due to multilateral contracts will be credibly enforced. Thus, the source of an inefficiency due to inter-regional externalities is not the asymmetry of information, but ill-defined supra-national legal rules. In this sense, information asymmetries add nothing to the general observation made by Coase (1960) that externalities have their source in missing property rights.

It is the explicit focus on an operational concept of coercive power and the minimum degree of centralization that distinguishes our approach from most of the literature. In Bordignon/Manasse/Tabellini, the coercive power of the centralized authority is exogenous and unrestricted. The same holds true for Bucovetsky/Marchand/Pestieau, Crémer/Pestieau, and Dhillon/Perroni/Scharf. In Lockwood it is exogenous but restricted. Bucovetsky/Marchand/Pestieau and Crémer/Pestieau restrict attention to the completely centralized organization structure (CC), whereas Dhillon/Perroni/Scharf and Lockwood restrict attention to the partly centralized case (PC). Dhillon/Perroni/Scharf focus on partly decentralized (PD) structures but exclude voluntary transfer payments between regions. Hence, all these papers restrict attention to the analysis and interpretation of the direct-revelation principle without looking for strategically equivalent indirect mechanisms, which would allow to answer the question of minimum centralization. The paper by Bordignon/Brusco (2000) on secession rules introduces an interesting new aspect into the discussion about the structure of federal states. They explicitly take into consideration that coercive power is restricted in the sense that regions can break a constitutional contract and fight an independence war. This possibility adds an additional restriction which is relevant for the set of implementable allocations. Optimal secession rules necessary to avoid wasteful conflicts might be counterproductive if information is asymmetrically distributed among regions.

Concerning the question of implementability, our paper is probably most closely related to Lockwood's (1999). He also finds that with unrestricted coercive power, risk neutrality does not restrict the set of implementable allocations compared to the situation of full information. However, he does not focus on the question of minimum centralization and does not derive an operational concept of coercive power.

There are other aspects in which our paper differs from most of the literature. All papers except for Lockwood restrict attention to two types and two regions whereas in this paper, the type space is continuous and the number of regions may be large. Boadway/Horiba/Jha (1999) and Bordignon/Manasse/Tabellini (in parts) analyze moral-hazard problems, whereas our analysis focuses on adverse selection. Bordignon/Manasse/Tabellini, Crémer/Pestieau,



Bucovetsky/Marchand/Pestieau (in parts) and Lockwood (in parts) focus on inter-regional risk-sharing, whereas our paper as the one by Dhillon/Perroni/Scharf is concerned with inter-regional externalities.

The organization of the paper is as follows: Section 2 presents a model of inter-regional competition with mobile tax bases. In Section 3 we characterize the first-best optimum with complete information. In Section 4 the role of information asymmetries for the implementability of first-best allocations is analyzed, and we develop and interpret institutions that implement the optimal allocation. Section 5 concludes.

## 2 The model

We analyze the case of capital mobility. This is done for the sake of exposition. The analysis extends without any qualitative differences to other forms of inter-regional market integration like labor mobility.

Consider an economy with  $n$  regions. There are rich and poor individuals in every region. Poor individuals are totally unproductive whereas rich individuals (inelastically) supply one unit of labor in their region of residence and are the owners of capital. Hence, labor is immobile both with respect to individual supply as well as with respect to the region where it is supplied. W.l.o.g we normalize the population of rich and poor of region  $i = 1, \dots, n$  to one. Total capital in all regions is equal to  $K$ , whereas the rich in region  $i$  owns  $\bar{K}_i$ ,  $\sum_{i=1}^n \bar{K}_i = K$  units of capital. The distribution of capital ownership may differ across regions. Every region produces a private good  $x_i$  by the use of capital and labor under constant returns to scale. The production function in intensity form is Inada and given by

$$x_i = f_i(k_i), \tag{1}$$

where  $k_i = K_i/L_i = K_i/1$  is the capital intensity per worker in region  $i$ . We denote by  $f'_i(\cdot)$  the marginal productivity of capital and by  $\bar{k}_i = \bar{K}_i/L_i$  capital ownership per worker. Capital markets are perfectly integrated and capital is costlessly mobile across regions. Firms maximize profits.

The poor of region  $i$  rely on transfers. These transfers are financed by the use of a source-based proportional tax  $\tau_i$  on the capital stock  $k_i$  used in region  $i$ .<sup>3</sup> The consumption

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<sup>3</sup>It could be argued that the inefficiency of the tax system is an artefact of the model because it exogenously excludes the use of residence based capital taxes or wage taxes. The purpose of this paper is, however, not to *explain* the non-availability of lump-sum taxes but the institutional consequences if an inter-regional

level of a poor,  $c_i$ , is therefore

$$c_i = \tau_i k_i. \quad (2)$$

In addition there exists a source tax on capital  $T_i$  that is used to finance the incentive mechanism derived in the following sections. The rich in region  $i$  consumes the residual income

$$y_i = f_i(k_i) + r\bar{k}_i - (r + \tau_i + T_i)k_i. \quad (3)$$

Our model applies as well to social assistance where rich and poor can be taken literally, to public pensions where rich are the current workers and poor are the current pensioners, or unemployment insurance where rich are the currently employed and poor are the currently unemployed individuals. Alternatively  $c_i$  can be interpreted as a regional public good.<sup>4</sup>

Regions might differ in their preferences for redistribution. This preference is determined by the *type*  $\theta_i \in \Theta_i$  of the region, where  $\Theta_i$  is a compact subset of  $\mathbb{R}^+$ . We denote by  $\theta = \{\theta_1, \dots, \theta_n\} = \{\theta_i, \theta_{-i}\} \in \Theta = \Theta_1 \times \dots \times \Theta_n$  a type profile of the regions.

Let  $\tau = \{\tau_1, \dots, \tau_n\} = \{\tau_i, \tau_{-i}\}$ ,  $T = \{T_1, \dots, T_n\}$  be the vector of regional capital-tax rates where  $\tau_{-i}$  ( $T_{-i}$ ) denotes the tax rates of all regions except of  $i$ . Capital-market integration implies the following arbitrage conditions:

$$\begin{aligned} f'_i(k_i) - \tau_i - T_i &= f'_j(k_j) - \tau_j - T_j \quad \forall \quad i, j = 1, \dots, n, i \neq j, \\ \sum_{i=1}^n k_i &= K. \end{aligned} \quad (4)$$

$f'_i(k_i) - \tau_i - T_i$  is always non negative because on the Inada conditions. (4) shows that production efficiency can only be achieved if  $\tau_i + T_i = \tau_j + T_j$  for all pairs  $i, j$ . Using the implicit-function theorem we can determine the effect on  $k_i$  of a change in  $\tau_j$ .

$$\begin{aligned} \frac{dk_i}{d\tau_i} &< 0, i = 1, \dots, n, \\ \frac{dk_i}{d\tau_j} &> 0, i \neq j. \end{aligned} \quad (5)$$

externality exists. In order to reach this goal one could for example assume that the public good cannot be financed out of wage taxes alone and that there is no information-clearing system among countries that would enable them to use a residence tax on capital income.

<sup>4</sup> $c_i$  is interpreted as the consumption level of the poor. The poor, however, do not play any active role in the economy which implies that their consumption level can alternatively be interpreted as the consumption level of the rich of a second, public, good. The regional objective function (6) would then be the utility function of a rich individual and no aggregation of utilities.

We want to restrict attention to the effects of capital-market integration on the efficiency of national redistributive policies. Thus, other sources of efficiency-enhancing inter-regional redistribution will be ruled out. The most prominent example of additional efficiency gains due to integration is the inter-regional diversification of region-specific risks. For example, it could be assumed that regions would like to insure against the risk of becoming a “bad” type  $\theta_i$ . As a consequence, some kind of inter-regional redistribution would turn out to be optimal. We restrain from this assumption and concentrate on intra-regional redistribution in this paper. An analogous argument can be established, however, for the case of inter-regional risk sharing.

In order to concentrate on redistribution within a region we assume that every region chooses  $\tau_i$  to maximize a quasi-linear objective function:

$$U_i = u(y_i, \theta_i) + c_i, \quad (6)$$

with  $u'(\cdot, \theta_i) > 0, u''(\cdot, \theta_i) < 0$ .<sup>5</sup> As usual in the literature we assume that the single-crossing property is fulfilled in order to avoid bunching of types:

$$\frac{\partial u(y_i, \hat{\theta}_i)}{\partial y_i} > \frac{\partial u(y_i, \bar{\theta}_i)}{\partial y_i} \Leftrightarrow \hat{\theta}_i > \bar{\theta}_i \quad \forall \quad i = 1, \dots, n. \quad (7)$$

This objective function has several possible interpretations. It can either be the ex-ante utility function of an individual that faces the risk of getting poor or the ex-post utility function of a rich who pays voluntary transfers to the poor. Alternatively it can be a utilitarian social-welfare function or a political-support function where poor individuals' utility is linear in income and both groups have equal weight. The regional optimization problems are interdependent due to the arbitrage conditions (4) implied by the integrated capital market. The arbitrage conditions give rise to functions  $k_i(\tau, T)$ . Inserting (1), (2), (3) in (6) gives the following utility function for region  $i$ :

$$U(\tau, T, \theta_i) = u(f_i(k_i(\tau, T)) + r\bar{k}_i - (r + \tau_i + T_i)k_i(\tau, T), \theta_i) + \tau_i k_i(\tau, T). \quad (8)$$

Thus, an equilibrium allocation  $\{k_i, c_i, x_i, y_i\}_{i=1, \dots, n}$  is completely determined by a vector of tax instruments  $\tau, T$ .

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<sup>5</sup>We denote by  $u_i, U_i, U_i$  functions  $u, U, U$  at  $\theta_i$  if no confusion is possible.

### 3 Implementable allocations with complete information

We will first analyze the optimal allocation with complete information. In order to do so we assume that a central planner maximizes the sum of regional objective functions (8) by the choice of capital-tax rates under the assumption that the incentive taxes  $T$  are equal to zero (CC). The planner is restricted to use the same instruments as the decentralized authorities. This assumption makes sure that it is not a superior access to instruments that explains potential advantages of centralization, but the asymmetry of information.<sup>6</sup>

$$\max_{\tau_1, \dots, \tau_n} W(\tau, 0, \theta) = \sum_{i=1}^n U(\tau_i, \tau_{-i}, 0, \theta_i). \quad (9)$$

An optimal allocation – or an optimal vector of taxes – is characterized by the following conditions  $\forall \theta_i \in \Theta_i \quad \forall i = 1, \dots, n$ :

$$\begin{aligned} \frac{\partial W}{\partial \tau_i} &= \frac{\partial U(\cdot, \theta_i)}{\partial \tau_i} + \sum_{j \neq i} \frac{\partial U(\cdot, \theta_j)}{\partial \tau_i} = 0, \\ &= -k_i \left( \frac{\partial u_i}{\partial y_i} - 1 \right) + \sum_{h=1}^n \tau_h \frac{dk_h}{d\tau_i} = 0. \end{aligned} \quad (10)$$

The latter equation stems from the definition of  $U_i$  and the conditions for profit maximization. (10) shows that source-based capital taxes are a second-best instrument even in the hands of a central planner. The first-best optimum with quasi-linear utility functions is characterized by  $\partial u_i / \partial y_i - 1 = 0$  (redistribution efficiency). (10) would be compatible with this condition if  $\tau_i = \tau_j \quad \forall i, j$ , because in this case, the second term would cancel (production efficiency). Equal tax rates, however, are only optimal if regions are identical. Hence, the central planner has to balance two distortions with one instrument, the underprovision of redistribution against the misallocation of capital. If, however, the world is such that only one instrument is feasible, the relevant optimum is characterized by (10).

Given the structure of the optimum it follows from (4) that  $T_i = T_j$  in order not to induce any further distortions: if the tax base of an incentive mechanism is the source tax on capital, every region has to pay the same tax rate. Because of the quasi-linearity of the utility functions a positive tax has no influence on the marginal rates of substitution because

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<sup>6</sup>In order to understand the specific role of information for the allocation of responsibilities we will restrict attention to a situation that is symmetric with respect to instruments between centralized and decentralized authorities.

all income effects are absorbed by the linear term of the utility function. We denote taxes that fulfill the requirement  $T' = \{T'_1, \dots, T'_n\}$  in the following.

The above conditions specify the general principle for first-best solutions that we will call “principle of marginal consideration” in the following: an institution induces efficient incentives if and only if every actor internalizes (marginally) the total effect of his decision on him and all other actors given the set of admissible instruments. The problem of institutional design is to find institutions that are compatible with (10).

We will first analyze a decentralized equilibrium (CD) where regions are restricted to set regional tax rates. In this case the common fiscal externality arises: every region solves

$$\max_{\tau_i} U(\tau_i, \tau_{-i}, 0, \theta_i), \quad (11)$$

which yields the following first-order conditions:

$$\frac{\partial U(\cdot, \theta_i)}{\partial \tau_i} = -k_i \left( \frac{\partial u_i}{\partial y_i} - 1 \right) + \tau_i \frac{dk_i}{d\tau_i} = 0 \quad \forall \quad \theta_i \in \Theta_i \quad \forall \quad i = 1, \dots, n. \quad (12)$$

A comparison with (10) reveals that if regional governments are restricted to set source-based tax rates, they do not take into account the effect of their decision on the welfare of all other regions due to a reallocation of capital, thus, the incentives induced by this institution are incompatible with (10).

Both institutions (CC) and (CD) differ with respect to the structure of underlying supranational rules. Whereas in (CD) no such rule exists, in (CC) there is a rich set of reliable rules enabling the central planner to set tax rates as well as to sufficiently punish national deviations from these centralized policies. This observation suggests that an argument in favor of centralization that stems from a comparison of these two equilibria is somewhat misleading: if it has been possible for the national authorities to delegate full authority to a central planner, it should have been possible to delegate a restricted set of rights to this agent as well. In other words, we cannot be sure that redistributive policies should be centralized before we have checked (PD) and (PC) equilibria.

For example Wildasin (1991) has shown that with complete information, a centralized authority can set transfer payments  $t$  that induce the right incentives to set tax rates in every region (PC). (PD) has been analyzed for the case of complete information by Myers (1990) who demonstrated the efficiency as well. Hence, with complete information there is neither an argument for the the centralization of redistributive policies nor for the centralization of incentive payments. We will now check whether something new is added to this logic if information is asymmetrically distributed across regions.

## 4 Implementable allocations and centralization

The incorporation of information asymmetries leads to two questions that have to be answered in the following.

1. We have to ask whether the asymmetry of information restricts the set of implementable allocations compared to (10). In other words, can the full-information optimum still be implemented if  $\theta_i$  is private information, or is it no longer the relevant benchmark with asymmetric information?
2. Depending on the answer to the first question, can the relevant optimum be supported using decentralized mechanisms (CD), (PD), or (PC), or do we have an argument in favor of centralization (CC)?

We assume that the type  $\theta_i$  of region  $i$ ,  $i = 1, \dots, n$ , is private information of region  $i$ . Thus, neither regions  $j$ ,  $j \neq i$  nor the centralized authority knows  $\theta_i$ . Every region assumes that the other regions are of type  $\theta_{-i} \in \Theta_{-i}$  with probability  $p(\theta_{-i})$ . The density functions are assumed to be continuous. All types are statistically independent. The set  $\Theta$  and the ex-ante density function  $p(\cdot)$  are common knowledge. Let  $\mathbf{E}[\cdot]$  be the expected value of  $[\cdot]$  and  $\mathbf{E}_i[\cdot]$   $i$ 's contingent expected value of  $[\cdot]$  given the realization  $\theta_i$ .

Region  $i$  may receive or may have to pay a transfer  $t_i$ ,  $i = 1, \dots, n$ . We denote by  $t = \{t_1, \dots, t_n\}$  the vector of transfers. Its aim is to internalize the above mentioned externality due to the combination of market integration and source-based taxes. This implies that there must exist at least a set of supra-national rules that guarantees the credible enforcement of the payment of these transfers and the conditions attaching thereto. This implies that (CD) is incompatible with optimality.<sup>7</sup> There are no outside funds in order to finance transfers and the only tax base that can be used is the source tax on capital.

We assume a pre-play, *ex-ante* stage before the regions learn their types where the countries can agree to delegate authority to this centralized authority. We will call the period when regions learn their type *ex post* in the following. Every region has to choose its tax rate  $\tau_i$  simultaneously. We look for Bayesian-Nash equilibria of this game.

In the absence of a centralized authority (CD), every regional government solves

$$\max_{\tau_i} \mathbf{E}_i [U(\tau_i, \tau_{-i}, 0, \theta_i)] \quad \forall \quad i = 1, \dots, n.$$

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<sup>7</sup>An even stronger argument in favor of decentralization would result if the game is repeated. In this case, the folk-theorem implies that under fairly weak conditions coordination to the optimal policies is possible even without formal authority (CD).

The corresponding tax rates are assumed to be unique and denoted by

$$\tau_i^{CD} = \arg \max_{\tau_i} \mathbf{E}_i [U_i(\tau_i, \tau_{-i}, 0, \theta_i)] \quad \forall \quad i = 1, \dots, n.$$

Taking this solution as a benchmark, the implementation of an institution that has the first best as an equilibrium is a Pareto improvement for each region from an ex-ante point of view.

An institution is identified with a game that completely specifies moves and strategies of all actors. Thus, formally it is equivalent to a mechanism, and different degrees of centralization correspond to different mechanisms. This is a rather restrictive interpretation of real-world institutions because of the exact specification of the sequencing of the game necessary to define a game whereas a lot of ambiguity exists in real-world negotiations.<sup>8</sup>

In order to characterize the relevant optimum with asymmetric information we can restrict attention to mechanisms  $M = (\theta, t)$  for which the truthful revelation of types is a Bayesian-Nash equilibrium and that implies redistribution parameters compatible with the solution of  $\max \mathcal{W}(\tau, \theta)$  due to the direct-revelation principle. The direct revelation principle is, however, only of limited interest for the evaluation of the efficiency of real-world institutions which in general have the form of more complicated or *indirect* mechanisms. If a direct mechanism exists that implements the first-best solution, there might exist several other *indirect* mechanisms that have the same allocation as an equilibrium. Hence, the use of the direct-revelation principle enables us to characterize the relevant normative benchmark. In order to answer question 2 we have to look for mechanisms that can be interpreted as decentralized institutions and that are strategically equivalent to the direct mechanism.<sup>9</sup>

The regional objective function for the determination of an optimal signal  $\hat{\theta}_i$  is:

$$\mathbf{E}_i [U(\tau(\hat{\theta}_i, \theta_{-i}), T, \theta_i) + t_i(\hat{\theta}_i, \theta_{-i})]. \quad (13)$$

A direct mechanism implements the first-best allocation if truth telling is a Bayesian-Nash equilibrium of the game,  $\hat{\theta}_i = \theta_i \quad \forall \quad i = 1, \dots, n$ . The necessary conditions for an optimum are

$$\frac{\partial \mathbf{E}_i [U(\tau(\theta_i, \theta_{-i}), T, \theta_i)]}{\partial \hat{\theta}_i} + \frac{\partial \mathbf{E}_i [t_i(\theta_i, \theta_{-i})]}{\partial \hat{\theta}_i} = 0 \quad \forall \quad i = 1, \dots, n. \quad (14)$$

<sup>8</sup>See Hellwig (1987) for a critique of game-theoretic models to analyze phenomena of adverse selection.

<sup>9</sup>The use of models for which the direct-revelation principle applies results in a centralization bias because the direct mechanism can always be interpreted as a central-planner mechanism. Hence, this class of models does not allow to focus on the particular advantages of decentralization.

Without loss of generality we restrict attention to transfer systems

$$t_i(\hat{\theta}) = s_i(\hat{\theta}) + \gamma_i.$$

Following (10), it is obvious that that every region (marginally) has to face the centralized governments' optimization problem in order to implement the first-best allocation.<sup>10</sup> Assume  $\gamma_i = 0$  and  $T_i = 0$  for the moment. If the government in region  $i = 1, \dots, n$  receives a transfer

$$s_i(\hat{\theta}) = \mathbf{E} \left[ \sum_{j \neq i} U(\tau(\hat{\theta}), 0, \theta_j) \right] \quad (15)$$

and all other regions report truthfully, its optimization problem is

$$\max_{\hat{\theta}_i} \mathbf{E}_i \left[ U(\tau(\hat{\theta}_i, \theta_{-i}), 0, \theta_i) + \sum_{j \neq i} U(\tau(\hat{\theta}_i, \theta_{-i}), 0, \theta_j) \right].$$

This mechanism induces the right incentives for the truthful revelation of types. We will call it 'uncompensated Groves mechanism' in the following. The problem, however, is, that it is not feasible because it runs an expected deficit

$$D = (n-1) \mathbf{E} \left[ \sum_{i=1}^n U(\tau(\theta), 0, \theta_i) \right].$$

The crucial question therefore becomes whether it is possible to balance the budget of the centralized government: deficits are impossible due to a lack of external funds, whereas surpluses are incompatible with efficiency. Thus, efficiency requires

$$\sum_{i=1}^n t_i(\theta) = 0.$$

In order to balance the budget one can use payments  $\gamma_i$ . These payments do not alter incentives for the regional governments and are therefore incentive compatible. In addition, the restriction on the tax base requires

$$-\sum_{i=1}^n \gamma_i = nT'_i,$$

This condition imposes a stricter restriction than  $\sum_{i=1}^n s_i(\theta) = -\sum_{i=1}^n \gamma_i$  because every region has to face the same tax rate in order to guarantee the second-best capital-market distortion.

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<sup>10</sup>See Groves (1973) and Green/Laffont (1979).



Hence, if a tax rate  $T'_i$  balances the budget this tax rate corresponds to a general transfer scheme  $\gamma_i$  that balances the budget, but not vice versa. However, the quasi-linearity of the utility functions implies that  $T'$  can be seen as a special case of the general scheme  $\gamma$ . We will treat both cases independently in order to show the restriction imposed by the use of source-based capital taxes.

As we have argued above, a change in  $T'$  does not change the marginal conditions because utility functions are quasi linear. Is it possible to choose  $\gamma$  or  $T'$  in order to balance the budget? The maximum amount of payments that can be extracted from region  $i = 1, \dots, n$  depends on the coercive power the centralized government can exercise. This power is made operational as the minimum utility level of region  $i$ ,  $U_i^M(\theta)$ , that the centralized government has to respect in its choice of  $\gamma_i$  or  $T'_i$ . This reservation utility defines an upper bound on the lump-sum payments a region has to pay. Maximum coercive power of the centralized authority is equivalent to  $U_i^M(\theta) = -\infty$ . Minimum power means that the utility of a region cannot fall short of the level reached in a decentralized equilibrium,  $U_i^M(\theta) = E_i [U_i(\tau^D, 0, \theta_i)]$  (participation is voluntary from an ex-post point of view).<sup>11</sup>

The degree of power of the centralized authority to exercise compulsion gives rise to participation constraints

$$E_i [U(\tau(\theta), T, \theta_i) + s_i(\theta)] \geq U_i^M(\theta) \quad \forall \quad \theta_i, \quad i = 1, \dots, n. \quad (16)$$

If one can use general schemes  $\gamma$ , the maximum payment that can be extracted from region  $i$  is therefore restricted by

$$M_i^\gamma := \inf_{\theta_i} \{E_i [U(\tau(\theta), \theta_i) + s_i(\theta)] - U_i^M(\theta)\}. \quad (17)$$

It is equal to the minimum gain from participation in the mechanism of region  $i$ . Let  $M_i^D$  be the minimum payment if participation is voluntary. The maximum total amount of payments that can be extracted from the regions is  $M_1^\gamma + \dots + M_n^\gamma$ .

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<sup>11</sup>The definition of the decentralized Nash equilibrium without transfers as benchmark is somewhat arbitrary for an  $n$ -region model. It implies that all regions agree not to implement any mechanism in the case that at least one region decides not to participate. In the  $n$ -region case, this threat might not be subgame perfect because constellations are likely where some regions agree to coordinate their tax rates, whereas the others free ride on the agreement, that Pareto-dominate the above Nash-equilibrium. Taking such situations as benchmark would have an influence on the reservation utility of the regions. However, as we will see in the following, the exact specification of the reservation utility has a quantitative but no qualitative effect on our results.

If one is restricted to schemes  $T'$  The maximum payment that can be extracted from region  $i$  is as before

$$M_i^T := \inf_{\theta_i} \{ \mathbf{E}_i [U(\tau(\theta), \theta_i) + s_i(\theta)] - U_i^M(\theta) \}, \quad (18)$$

which is the same as above,  $M_i^T = M_i^\gamma$ . However, total payments are given by

$$n \cdot \min_i \{ M_1^T, \dots, M_n^T \}, \quad (19)$$

because every region has to face the same tax rate. We can summarize with the following result:

**RESULT 1:** For given participation constraints  $U_i(\theta, 0)$  the complete-information optimum can be implemented with asymmetric information if the sum of minimum gains from participation,  $M_i^\gamma$  ( $M_i^T$ ), exceeds the expected deficit of an uncompensated Groves mechanism,  $D$ ,  $D \leq \sum_{i=1}^n M_i^\gamma$  ( $D \leq \min_{i=1}^n M_i^T$ ).

This result is instructive. It tells us that the first-best, full-information allocation can still be implemented in the case of asymmetric information if both countries' minimum gain from participation is large enough; inter-regional externalities can be completely internalized even in the case of asymmetric information. There is a quantitative difference between the use of general transfer schemes and transfer schemes that have to be financed from the revenues of the source tax. In the latter case, efficiency requires equal tax rates  $T_i'$  for all regions, which implies that the gain from participation of the country that profits least has to be large enough. This has an important consequence: with a general scheme  $\gamma$  it is possible that some regions *receive* a fixed payment  $\gamma_i$ , whereas this is impossible for a special scheme  $T'$ . This has important consequences for a specific class of externalities. Asymmetric externalities in the sense that (a) one region profits at the costs of another region and (b) internalization implies a welfare gain according to the potential Pareto criterion cannot be efficiently internalized if the countries are restricted to use a source tax on capital in order to balance the mechanism. The reason is that one region would have to receive a positive payment in order to be better off in expectations. These externalities, however, can potentially be internalized with a general scheme  $\gamma$ .

It is worthwhile noting that the additional restriction applies irrespective of the degree of centralization as long as the set of instruments is the same.

The difference between both types of transfer schemes is restricted to the aggregation rule as has been shown above. Hence, in order to have a lean notation we will derive conditions

for the existence of optimal mechanisms for the case of a general transfer scheme  $\gamma$  but give the results for both,  $\gamma$  and  $T$  in the following. We denote by  $M_i$  the maximum payment by region  $i$  for system  $\gamma$ . Assume that the regions start from a decentralized equilibrium. In this case,

$$M_i^{CD} := \inf_{\theta_i} \left\{ \mathbf{E}_i [U(\tau(\theta), 0, \theta_i) + s_i(\theta)] - \mathbf{E}_i [U(\tau_i^{CD}, 0, \theta_i)] \right\}. \quad (20)$$

If  $D \leq \sum_{i=1}^n M_i^{CD}$ , the implementation of a compensated Groves mechanism is an ex-post Pareto improvement for the economy. If, on the other hand,  $D \geq \sum_{i=1}^n M_i^{CD}$ , it is only an ex-ante improvement because the ex-post participation constraint of at least one region has to be violated. In the latter case, the implementation of a first-best institution is only possible if either the regions have to decide on its implementation before they learn their types or if one restricts attention to potential Pareto improvements. If one sticks to the Pareto-criterion ex post, one is restricted to the implementation of ‘third-best’ institutions.

**RESULT 2:** With voluntary participation the complete-information optimum can be implemented with asymmetric information if

- a) for a general transfer scheme  $\gamma$  the sum of minimum gains from participation compared to the decentralized equilibrium,  $M_i^{CD}$ , exceeds the expected deficit of an uncompensated Groves mechanism,  $D$ ,  $D \leq \sum_{i=1}^n M_i^{CD}$ , and
- b) for a source-tax transfer scheme  $T'$   $n$  times the minimum of the minimum gains from participation compared to the decentralized equilibrium,  $M_i^{CD}$ , exceeds the expected deficit of an uncompensated Groves mechanism,  $D$ ,  $D \leq n \cdot \min_{i=1}^n \{M_i^{CD}\}$ .

Thus, situation (PD) is compatible with the implementation of an optimal institution even if the supra-national rules are only implemented ex post if the gains from coordination are large enough. We can now identify two potential reasons that might defeat the implementation of the first best.

- **Participation in the mechanism is voluntary ex post and minimum gains from participation are insufficient.** In other words, regions are not able to credibly commit *ex ante* to participate *ex post*. This lack of commitment makes it impossible to implement the first-best allocation. Nevertheless, problems of credible commitment are *not ideosyncratic* to the asymmetry of information. Qualitatively the same problem arises if information is perfect. Even with perfect information inter-regional transfers are needed to internalize the externality induced by the source tax. The transfer

mechanism has, however, a different structure. A comparison of (10) with (12) shows that a transfer  $t_i = \sum_{h \neq i} \tau_h k_h + \gamma_i, i = 1, \dots, n$  induces the right incentives for each region to set tax rates efficiently. However, the implementability of such a transfer scheme depends on the ability of the regions to credibly commit to actually pay the transfers. Hence, the bi- or multilateral contract has to be enforceable.

- **The mechanisms analyzed are imperfect despite the fact that efficient mechanisms exist in principle.** One reason might be that the set of transfer instruments is limited in a way that makes it impossible to support the efficient solution by the use of a decentralized institution. One example for this is Dhillon/Perroni/Scharf. They analyze optimal mechanisms in a situation where inter-regional transfers  $t$  are exogenously excluded. Therefore we have to conclude that the source of their inefficiency is a lack of instruments, not the information problem. The structure of the second-best solution, however, might be different if information is incomplete compared to a situation with complete information. To summarize, the asymmetry of information is *not* the *additional* source of inefficiency in this case despite the fact that it may have an influence on the quantitative nature of the second-best mechanism.

We now turn to the second question of optimal institutions in the case of existence of first-best mechanisms. The simplest idea in order to design such an institution is to directly use the direct mechanism. The following two corollaries follow directly from result 1:

**COROLLARY 1:** With the above assumptions, there exists an ex-post-efficient, individually-rational, Bayesian incentive-compatible (PC) mechanism if the centralized government has unrestricted coercive power.

**COROLLARY 2:** The minimum (aggregate) coercive power to tax or punish regions that has to be given to the centralized authority in order to make an optimal mechanism implementable is given by  $D$ .

Corollary 1 has first been proved by d'Aspremont/Gérard-Varet (1979) and Arrow (1979): if the centralized government has unrestricted power to exercise compulsion,  $M_i = \infty, i = 1, \dots, n$ . Thus, let

$$t_i(\theta) = \mathbf{E}_i \left[ \sum_{j \neq i} U(\tau(\theta), \theta_j) \right] - \sum_{j \neq i} \mathbf{E}_j \left[ \sum_{k \neq j} U(\tau(\theta), \theta_k) \right]. \quad (21)$$

The latter term is independent of the signal  $\theta_i$  and has therefore no influence on the incentives of region  $i$ . Aggregation over  $t_i$  gives the desired result. We will call this institution AGV (d'Aspremont/Gérard-Varet) mechanism in the following.

The AGV mechanism corresponds to (PC) and has the following structure: for every vector  $\theta$  of types, a first-best vector of taxes  $\tau(\theta)$  can be defined and implemented by the use of a state-contingent contract if the centralized authority can be sure that the types are truthfully revealed. By announcing a wrong type, a region chooses a different level of transfers. Thus, compared to the announcement of the true type, a region creates an externality in the other region due to the change in redistribution policies and the induced reallocation of the mobile factor. This mechanism internalizes the externality in the following way: region  $i$  gets paid the expected value (minus a constant) of the other countries' surpluses conditional on its own report. Thus, (10) is fulfilled in every region. Due to the fact that every region (marginally) faces the central planners' problem, a misrepresentation of types will never be optimal.

This mechanism, despite its theoretical simplicity, can almost never be observed in reality. Regions do not announce their 'types' and get transfers according to these signals. In the European Union, for example, the social, structural, and regional funds are financed using *ax ante* negotiated lump-sum payments whereas benefits are calculated according to certain key parameters like average income, indices of industrialization, or economic performance.<sup>12</sup>

There might be, however, other mechanisms that are strategically equivalent to the direct mechanism  $(\theta, t)$ . A particularly simple one is  $(\tau, \tilde{t})$  that uses regional tax rates as signals. We can construct a (net-) transfer scheme  $\tilde{t}$  that induces the right incentives to set  $\tau$  and is balanced as follows:

$$\tilde{t}_i(\tau) = \mathbf{E}_i \left[ \sum_{j \neq i} U(\tau_j, \tau_{-j}, \theta_j) \right] - \alpha_i(n-1) \mathbf{E} \left[ \sum_{j=1}^n U(\tau, \theta_j) \right], \quad \sum_{i=1}^n \alpha_i = 1. \quad (22)$$

Due to the monotonicity of  $\tau$  in  $\theta$ , region  $i$  has an incentive to set the optimal tax rate given its type  $\theta_i$  and transfer payments (22) if and only if it has an incentive to truthfully reveal its type given transfer payments (21).<sup>13</sup> We will call this mechanism AGV' in the following. The mechanism makes use of the fact that the unconditional expected value  $D$  of coordinating tax rates is independent of signals  $\hat{\theta}_i$  and that the expected deficit  $(n-1)D$  of the uncompensated Groves mechanism can be freely distributed across regions. One can

<sup>12</sup>See Armstrong/Taylor/Williams (1995).

<sup>13</sup>It can easily be checked that  $y$  and  $c$  need not be monotonous in  $\theta$ . Thus, mechanisms cannot be based on these variables in general.

think of this mechanism in the following way: first, regions pay  $\gamma_i$  (or  $T_i'$ ) to the centralized authority. Next, the centralized authority pays gross transfers  $s_i$  according to observed tax rates  $\tau$  to the regions.

This institution has the same structure as the AGV mechanism: redistributive policies  $\tau$  are allocated at the regional level and transfer payments  $t$  are set by a centralized authority (PC). We can therefore conclude that there is no need to centralize redistributive policies due to the integration of markets. We summarize with result 3:

**RESULT 3:** If the centralized authority has sufficient access to regional funds in order to balance its budget, the first best can be reached if redistributive policies remain decentralized whereas AGV or AGV' transfers are set and executed by the centralized authority.

Can we even do better and implement the optimum using (PD) institutions? In fact we can, as the following reflection on corollary 2 reveals: assume a (PD) institution in which the central authority has no access to taxes and transfers but has sufficient coercive power to punish deviations from bi- or multilateral contracts. Assume further that the regional authorities have coordinated on tax rates and bilateral transfers that would implement the optimum. Deviations from this rule are punished by the central authority using the AGV or AGV' transfers as penalties. It is immediately clear that such a rule makes the coordinated strategy credible. In this case, however, it is not the centralized authority who defines and administers the transfer payments. Its only role is to punish deviations from the decentralized rules. We summarize with result 4:

**RESULT 4:** Transfer payments as well as redistributive policies can be decentralized (PD) if regions can sign a multilateral contract that specifies transfers and the centralized authority can credibly commit to punish deviations from the transfer scheme.

This result stresses the classic role of a centralized authority as a night-watchman: there is no role for the centralized authority to administer redistributive policies. Its main role is to set and guarantee a set of rules and punishments that make bilateral contracts reliable.

To summarize, the full-information optimum can be implemented in the case of asymmetric information if a set of supra-national rules exists which makes sure that bi- and multilateral contractual obligations are credibly enforced. The necessary prerequisite for this is that the central authority has sufficient coercive power. Power in this context is made

operational by the participation constraints the central authority has to respect. Coming back to the full-information benchmark, this result implies no qualitative change. Even with complete information, supra-national anarchy is incompatible with optimality. Hence, national authorities have to delegate power to a supra-national rule-enforcing agency. There is, however, a quantitative difference between asymmetric and full information: Whereas it is always the minimum of the gains from trade that restricts the voluntary payments in the case of asymmetric information, it is the actual gains from trade that restricts  $M_i$  in the case of full information. This implies that voluntary participation is easier to achieve if information is symmetric.

## 5 Concluding Remarks

In this paper we have applied expected-externality mechanisms to the problem of decentralized redistribution policies in inter-regionally integrated markets. The (only) justification for inter-regional transfers has been some kind of tax-competition externality due to capital mobility and source-based taxes. Our findings can be summarized as follows:

1. Externalities due to decentralized redistribution policies in an economic union justify some minimum degree of centralization, namely the establishment of reliable supra-national rules. In the context of asymmetric information about redistribution preferences between local and centralized authorities, this does not imply the need to centralize redistributive policies itself. Rather it implies that the supra-national authority is vested with a minimum coercive power and, therefore, to tax or to punish regions for deviations from multilateral contractual obligations. If the authorities' power is sufficient, an expected-externality mechanism can be implemented that has the optimum allocation as an equilibrium.
2. The inefficiency results found in the literature can be attributed to two potential sources. First regional governments cannot credibly commit to fulfill the obligations of the mechanism. The optimal mechanism might give rise to negative net payments in some states of the world despite the fact that it is a Pareto-improvement ex-ante. If regions can avoid these payments without being punished, the optimum cannot be reached. This gives a strong argument for centralized government compulsion: only if the centralized authority has sufficient power to force the regions to meet their contractual obligations, the first best can be reached. Second, institutions induce inefficient incentives despite the fact that the optimum can be implemented in principle. This calls for institutional reforms in the direction of an optimal mechanism.
3. In the case of sufficient power, the optimal direct mechanism has a simple structure: it

(marginally) charges every region the expected externality created in the other region by the announcement of its redistribution type and the level of transfers from rich to poor.

4. Several institutions are compatible with this mechanism. First, redistributive policies can be centralized. This is the case some of the literature cited in Section 1 focuses on. Second, redistributive policies remain decentralized, whereas incentive payments are administered by the central authority. In this case, due to the monotonicity of tax rates in types, the mechanism can be either based on types or on tax rates. Third, redistribution policies as well as transfer payments can be decentralized. In this case, the central authority has to punish deviations from contractual obligations.

Thus, information asymmetries neither are an impediment to reach the optimum, nor do they necessitate the centralization of redistribution policies. There is no qualitative change to the full-information case: the source of externalities that occur in equilibrium is an ill-defined system of supra-national legal rules.

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