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Intergovernmental Grants and Financial Autonomy under Asymmetric Information

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Abstract

This paper analyses and compares the efficiency of alternative incentive compatible grant schemes under asymmetric information relieving subnational governments of excessive debt burden. They allow intervention into local debt, local tax or complete local fiscal policy. In the first case, separation of types can be induced by forcing recipients to inefficient high borrowing and in the second case by imposing inefficient high tax rates. In the last case, fiscal policy of the recipient region is distorted in the period of the exogenous shock. We show that constraining complete financial autonomy leads to the lowest welfare losses. This is due to the fact that complete regulation of local fiscal policy reduces the incentive of contributing local governments to defect from truthful relevation.

Keywords: vertical transfers, subnational debt, asymmetric information adverse selection, financial autonomy

JEL Codes: H74, H77, D82

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Finanzhilfen und Finanzautonomie unter asymmetrischer Information

Die folgende Arbeit untersucht und vergleicht die Effizienz alternativer vertikaler Zuweisungssysteme unter asymmetrischer Information. Anhand eines zwei-periodischen Modells werden konditionierte Finanzhilfen bei Eingriff in die lokale Kreditautonomie, die lokale Steuerautonomie sowie die gesamte lokale Finanzautonomie betrachtet. Damit Lokalregierungen ihren wahren Typen offenbaren, müssen Zuweisungsempfänger im ersten Fall sich ineffizient hoch verschulden und im zweiten Fall ineffizient hohe Steuersätze festlegen. Im letzten Fall werden die finanzpolitischen Handlungsparameter der Zuweisungsempfänger in der ersten Periode verzerrt. Unter allen Mechanismen führt der vollkommene Eingriff in die lokale Finanzpolitik zu den geringsten Wohlfahrtsverlusten, da der Anreiz eines reichen Landes, sich als arm auszugeben, am geringsten ist.

Keywords: vertikale Transfers, lokale Verschuldung, asymmetrische Information, adverse Selektion, Finanzautonomie

1 Introduction

Constitutional intergovernmental grants serve to secure the fulfillment of tasks by subnational governments that have run undeliberately into fiscal crisis. The grants can be seen as interregional insurance schemes that insure subnational states against the risk of exogenous shocks. However, interregional insurance may be subject to asymmetric information problems i.e. hidden information problems (Boadway (2006) (p. 371)). These problems arise when the government cannot observe the underlying shocks that hit the different states, but can observe the fiscal actions the states undertake. In the presence of asymmetric information, the central government has to deal with the problem of adverse selection. Local governments that are better off are inclined not to consolidate or to even run high budget deficits in order to receive additional grants meant for local governments suffering from exogenous shocks.

These hidden information problems possibly occur in some German states that have established a system of financial aid for municipalities suffering from budget deficits.[1] The grants are financed by contributions of the municipalities and are bound to fiscal requirements on taxes, on public debt levels or the development of expenses. The literature on optimal transfer schemes under asymmetric information has shown that transfer systems can constitute a screening device which makes subnational governments reveal their private information. By conditioning ex ante the disbursement of grants on observable local fiscal policy, spurious claims can be prevented, leading to more budget discipline. This paper aims to find the most efficient incentive compatible grant system under asymmetric information.

The analysis is based on the literature on optimal transfer systems under asymmetric information. Following Mirrlees (1971) and Stiglitz (1982), conditional grants are modelled as insurance contracts in a principal agent framework. According to the revelation principle, the central government (principal) provides specific transfers conditioned on specific fiscal actions for each type of subnational governments (agents). The transfer system is incentive compatible when the agent picks only the contract that is destined to him i.e. chooses the political action and thus the transfer that corresponds to his type. Under asymmetric information, the optimal grant scheme constitutes a second best solution. It involves two kinds of welfare losses in order to prevent adverse selection. Firstly, redistribution between the contributing region (high type) and the recipient region (low type) is incomplete. Secondly, the

[1] Examples are the "Fehlbetragszuweisungen" in the German state Schleswig-Holstein or "Bedarfszuweisungen" in Baden-Württemberg.

low type is forced to implement an inefficient fiscal policy whereas the fiscal policy of the high type is left undistorted. This characteristic is known as no distortion at the top, distortion at the bottom. In Bordignon et al. (2001), Lockwood (1999), Cornes and Silva (2000) and Huber and Runkel (2006) the transfer system imposes certain tax rates on subnational governments that differ in income, public demand or costs of local public goods. They show that low types – the regions that face low income, low productivity, high demand or high costs – have to choose inefficient tax rates, high types efficient ones. In Huber and Runkel (2008) the federal government intervenes into borrowing autonomy when intergovernmental transfers redistribute income from patient to impatient countries. To solve the adverse selection problem in the presence of asymmetric information, recipient countries are forced to implement stronger budget rules than the contributing countries. Few papers have so far analysed mechanisms in which transfers are conditioned on several fiscal parameters. A prominent paper is developed by Breuillé and Gary-Bobo (2007), in which high cost regions are faced with distortive interventions into financial autonomy. They receive transfers, if they reduce their tax rates and public expenses.

The literature has not yet analytically compared the efficiency losses of alternative grant systems.[2] This paper intends to close this gap and thus to contribute to the literature on incentive compatible transfer systems under asymmetric information. Building on the framework of Huber and Runkel (2008), the following two period model analyses and compares the efficiency of three different kinds of incentive compatible transfer systems. Financial aid is conditioned on

- local public debt level (intervention into debt policy)
- local tax rates (intervention into tax policy)
- all local fiscal parameters (intervention into complete fiscal policy)

In this model regions are hit differently by an exogenous shock on demand in the first period, which cannot be verified by the central government. Regions with high demand for local public goods need more resources in the first period and borrow more than regions with low demand. In the second period, a tax transfer system redistributes the excessive deficit burden of the high demand regions among all regions. The analysis confirms the result of the literature stated above. Under all mechanisms, the low types receive fewer transfers and high types pay fewer

[2] Jack (2005) opposes the effects of input oriented transfer mechanisms to output oriented transfer mechanisms, but does not analytically compare the two systems in terms of efficiency.

contributions compared to the first best solution. Contributing regions implement their optimal fiscal policy whereas recipient regions have to take suboptimal fiscal actions. We can show that the distributive effect serves to compensate the high type for his informational advantage. However, distortion at the bottom serves to reduce the informational rent given to the high type, as it reduces his incentive to mimic the low type. With regard to different transfer mechanisms, the paper delivers new insights. If transfers are conditioned on public debt levels, recipient states have to exhibit inefficient high debt levels. This result is contrary to the results of Huber and Runkel (2008) in which low types are forced to realize inefficient low debt levels. We can see that the kind of shock is a decisive factor in which direction the fiscal policy of the low type is distorted. In the case of constraining tax autonomy, low types have to raise inefficient tax rates in both periods, before they can claim financial aid. In the last case, recipient states have to choose inefficient fiscal policies only in the period in which the exogenous shock occurs. From the comparison of the three mechanisms, we can conclude that complete intervention into financial autonomy of the recipient states entails less welfare losses than partial intervention. As contributing regions are deprived of any financial scope to adjust fiscal parameters to the transfer requirements, they are less inclined to mimic the recipient region. Hence, the transfer scheme does not need to be as inefficient as under partial intervention to solve the adverse selection problem.

The paper proceeds as follows. Section 2 presents the set up of the model. Section 3 analyses the optimal transfer system conditioned on public debt level, and section 4 analyses the optimal transfer system conditioned on tax policy under complete and under asymmetric information. Optimal grant schemes that allow complete intervention into fiscal policy of the agents is provided in section 5. In section 6, the three transfer systems are compared in terms of efficiency. Section 7 discusses the outcome and concludes.

2 The model

Consider a two period model of a federation, consisting of a federal government and a large number of regions. Each region is populated by a representative individual, who consumes c_1^k and c_2^k units of a private good and g_1^k and g_2^k units of a local public good in period 1 and 2. Intertemporal utility of the individual is given by

$$U(c_1^k, g_1^k, c_2^k, g_2^k, \theta^k) = w_1\left(c_1^k\right) + \theta^k u_1\left(g_1^k\right) + w_2\left(c_2^k\right) + u_2\left(g_2^k\right) \tag{1}$$

with $u_1'(\cdot) > 0$, $u_1''(\cdot) < 0$, $w_1'(\cdot) > 0$, $w_1''(\cdot) < 0$ and $u_2'(\cdot) > 0$, $u_2''(\cdot) < 0$, $w_2'(\cdot) > 0$, $w_2''(\cdot) < 0$. In the first period, regions are hit differently by an exogenous shock $\theta^k \in \{\theta^h, \theta^l\}$, affecting the individual preference for local public goods. n^l $(n^l \geq 1)$ regions of type l have a higher demand for the local public good than the other n^h regions $(n^h \geq 1)$ of type h: $\theta^l > \theta^h$. For reasons of convenience, regions of type l are denoted as the low-type or poor regions, regions of type h as the high-type or rich regions.

The individual budget contraints in period 1 and 2 are

$$c_1^k = \left(1 - t_1^k\right) y_1 \tag{2}$$

$$c_2^k = \left(1 - t_2^k\right) y_2, \tag{3}$$

where y_1 and y_2 define the income and t_1^k and t_2^k the tax rate in period 1 and 2 of an individual in the region of type k. In the first period, a local public good g_1^k is financed by tax revenue as well as the issuance of debt b^k:

$$g_1^k = b^k + t_1^k y_1 \tag{4}$$

In the second period, debt b^k plus interest rb^k are paid back. The region receives a lump sum transfer $(m^k > 0)$ from or pays a lump sum tax $(m^k < 0)$ to the central government:

$$g_2^k = t_2^k y_2 - (1 + r) b^k + m^k \tag{5}$$

Tax revenue collected from the regions of type k sum up to the transfers payed to the regions of type $-k$. The central budget contraint is:

$$n^l m^l + n^h m^h = 0 \tag{6}$$

The choice of the transfers m^k, the tax rates t_1^k, t_2^k, and public debt levels b^k are defined by the following principal-agent-game:

(1) The central government (principal) sets the interregional transfer or transfer rule $\{(m^k, q^k)(m^{-k}, q^{-k})\}$. It is a function of observable fiscal parameters such as b^k or (t_1^k, t_2^k) or (b^k, t_1^k, t_2^k): $q^k \in \{(b^k), (t_1^k, t_2^k), (b^k, t_1^k, t_2^k)\}$
(2) The local government (agent) of type k chooses its optimal fiscal parameters b^k, t_1^k, t_2^k.
(3) The agent pay or receive transfers according to the transfer rule.

In line with the relevation principle defined by Myerson (1979) and (1983), the principal offers a contract menue that specifies a transfer and a political action for each type. Tax or transfer payments are confined to strategies each agent would choose if he truthfully revealed his type. Incentive compatibility of the transfer system requires that each agent chooses the strategy destined to his type. Following Huber and Runkel (2006) and (2008), we assume that numerous agents of each type k exist, which simplifies the analyses in two aspects: Firstly, the multi-agent-problem is reduced to a single-agent-problem. This implies that, different to the screening literature such as Bordignon et al. (2001), the principal does not have to regard strategic interaction between its agents on setting up an optimal transfer system. The adverse selection problem is solved, if an agent realizes at least the same utility level by choosing its own contract $\left(m^k, q^k\right)$ than by choosing the contract of the other type $\left(m^{-k}, q^{-k}\right)$. Secondly, we relax the assumption of uncorrelated types. In the screening literature correlation of types allows to set up a first-best-mechanism that retrieves the true information about types[3]. Yet, given the large number of agents, we assume that the implementation of a first-best-mechanism like a shoot-the-liar-mechanism (Fudenberg and Tirole (2000), p. 293) generates too high transaction costs to be credible.[4] Therefore, the alternative incentive compatible grant schemes defined in the following chapters appear to be the most efficient ways to extract private information about the types.

The transfers have to be optimally conditioned on observable fiscal parameters in order to rule out adverse selection. Solving by backward induction, the characteristics of the alternative incentive compatible grant schemes are identified, before the central government picks the one that involves the lowest welfare losses. The central government disposes of three different options: $q^k \in \left\{b^k, \left(t_1^k, t_2^k\right), \left(b^k, t_1^k, t_2^k\right)\right\}$. In the first case, the principal offers the transfer m^k for the debt level b^k. The agents are free to choose their local tax rates (section 3). In the second case, the transfers and the local tax rates in both periods ($q^k = \left(t_1^k, t_2^k\right)$) are set, while local governments choose public debt (section 4). In the third case, the central government intervenes completely into local financial autonomy ($q^k = \left(b^k, t_1^k, t_2^k\right)$), leaving the agents merely the choice between two contracts (section 5).

[3] McAfee and Reny (1992) show that private information is valueless, if types are correlated. In this case a first-best-solution can be achieved, as it is possible to design a mechanism that leaves the agents without any informational rent.

[4] A similar argument is brought forward by Crémer and McLean (1988), p. 1254f.

3 Grants intervening into debt policy

3.1 Local and central optimization

Intervention into borrowing autonomy of the regions involves the following procedure: (1) The central government defines the transfer m^k and the debt level b^k for each type of agent. (2) Local governments pick one of the two contracts $\left\{\left(b^h, m^h\right), \left(b^l, m^l\right)\right\}$ by selecting b^k and choose their tax rates t_1^k, t_2^k. Solving by backward induction, the choice of the tax rates t_1^k and t_2^k is determined by utility maximization:

$$\max_{t_1,t_2} \left\{w_1\left(\left(1-t_1\right)y\right)+\theta u_1\left(b+t_1 y\right)+w_2\left(\left(1-t_2\right)y\right)+u_2\left(yt_2-b\left(1+r\right)+m\right)\right\} \tag{7}$$

For simplicity, we disregard the index k. The first order conditions can be written as:

$$w_1'\left(c_{1B}\right) = \theta u_1'\left(g_{1B}\right) \tag{8}$$
$$w_2'\left(c_{2D}\right) = u_2'\left(g_{2D}\right) \tag{9}$$

Solving for the equations (8) and (9), the tax rate of the first period $t_{1B} = t_{1B}\left(b,\theta\right)$ is a function of the debt level and the preference parameter. The tax rate of the second period $t_{2B} = t_{2B}\left(b,m\right)$ is determined by public debt and the lump sum transfer. They exhibit the following characteristics $\frac{dt_1}{db} = -\frac{\theta u_1''(\cdot)}{w''(\cdot)y+\theta u_1''(\cdot)y} < 0$, $\frac{dt_2}{db} = -\frac{u_2''(\cdot)(1+r)}{w_2''(\cdot)y+u_2''(\cdot)y} > 0$, $\frac{dt_1}{d\theta} = -\frac{u_1'(\cdot)}{w_1''(\cdot)y+\theta u_1''(\cdot)y} > 0$ and $\frac{dt_2}{dm} = -\frac{u_2''(\cdot)}{w_2''(\cdot)y+u_2''(\cdot)y} < 0$.

Anticipating the tax policy of the agents, the benevolent principal sets the optimal transfer system $\left\{\left(b^h, m^h\right), \left(b^l, m^l\right)\right\}$ on the basis of the individual indirect utility functions:

$$V\left(b,m,\theta\right) = \max_{t_1,t_2} \left\{w_1\left(\left(1-t_1\right)y\right)+\theta u_1\left(b+t_1 y\right)+w_2\left(1-t_2 y\right)+u_2\left(yt_2-b\left(1+r\right)+m\right)\right\} \tag{10}$$

The central government maximizes the sum of indirect utility of the regions, but has to regard incentive compatibility of the contract system to rule out adverse selection. Its maximization problem is defined by

$$\max_{\left\{m^k,b^k\right\}k\in\{h,l\}} \sum_k n^k V\left(b^k, m^k, \theta^k\right) \tag{11}$$
$$s.t.\ (6)$$

$$\begin{aligned} I.C.1 &: \quad V\left(b^h, m^h, \theta^h\right) \geq V\left(b^l, m^l, \theta^h\right) \\ I.C.2 &: \quad V\left(b^l, m^l, \theta^l\right) \geq V\left(b^h, m^h, \theta^l\right), \end{aligned}$$

where I.C.1 and I.C.2 are the incentive compatibility contraints or self selection constraints for type h and type l. The constraints say that a region of type k must be indifferent between telling the truth (i.e. setting the debt level b^k and realizing the transfer m^k) and choosing the contract of the other type $\left(b^{-k}, m^{-k}\right)$. Due to the assumption of the large number of agents stated above, defection does not affect the central budget constraint, as is apparent in I.C.1 and I.C.2. If type h defects, it will realize the same transfer as the truth telling poor region. Like in Huber and Runkel (2008) and Bordignon et al. (2001), the transfer system does not need to be approved by the local governments[5] so that we disregard participation constraints.

Using the envelope-theorem, the maximization problem (11) yields the following first order conditions:[6]

$$\left(n^h + \lambda_B^h\right) \theta^h u_1'\left(g_{1B}^h\right) - \lambda_B^l \theta^l u_1'\left(g_{1B}^h\left(\theta^l\right)\right) = \left[\left(n^h + \lambda_B^h\right) u_2'\left(g_{2B}^h\right) - \lambda_B^l u_2'\left(g_{2B}^h\right)\right](1+r) \tag{12}$$

$$\left(n^l + \lambda_B^l\right) \theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right) - \lambda_B^h \theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right) = \left[\left(n^l + \lambda_B^l\right) u_2'\left(g_{2B}^l\right) - \lambda_B^h u_2'\left(g_{2B}^l\right)\right](1+r) \tag{13}$$

$$\left(\frac{n^l + \lambda_B^l - \lambda_B^h}{n^l}\right) u_2'\left(g_{2B}^l\right) = \left(\frac{n^h + \lambda_B^h - \lambda_B^l}{n^h}\right) u_2'\left(g_{2B}^h\right), \tag{14}$$

where λ_B^h und λ_B^l are the Lagrange-multipliers of I.C.1 and I.C.2. For simplification the following notations are applied: $g_{1B}^h = b_B^h + t_{1B}\left(\theta^h\right) y$, $g_{1B}^h\left(\theta^l\right) = b_B^h + t_1\left(\theta^l\right) y$, $g_{2B}^h = t_{2B}^h y - (1+r) b^h + m^h$, $g_B^l = b_B^l\left(\theta^l\right) + t_{1B}\left(\theta^l\right) y$, $g_{1B}^l\left(\theta^h\right) = b_B^l + t_{1B}\left(\theta^h\right) y$, $g_{2B}^l = t_2^l y - b^l (1+r) + m^l$.

3.2 Optimal grants under full information

In the first best case the principal has full information about the types and can sanction misbehaviour. He does not need to regard incentive compatibility of the

[5] Strategic interaction between two countries would change the central budget constraint in the case of defection. Assuming that both types chose the strategy of type l, the central budget constraint requires that both players do not receive a transfer. I.C.1 would change to $V\left(b^h, m^h, \theta^h\right) \geq V\left(b^l, 0, \theta^h\right)$. See for example Bordignon et al. (2001), p. 716.

[6] Subscript B describes the case of intervention into local debt policy.

transfer system. I.C.1 and I.C.2 can be dropped, so that $\lambda_B^h = 0$ and $\lambda_B^l = 0$. We obtain

Proposition 1 *Under full information the optimal transfer scheme satisfies the conditions:*

$$\theta^k u_1' \left(g_{1FB}^k\right) = (1+r)\, u_2' \left(g_{2FB}^k\right) \tag{15}$$
$$u_2' \left(g_{2FB}^k\right) = u_2' \left(g_{2FB}^{-k}\right) \tag{16}$$

Complete equalization of the marginal rates of consumption between public and private goods within one period, between individuals and between periods is achieved. The transfer system $m_{FB}^h < 0 < m_{FB}^l$ leads to $b_{FB}^l > b_{FB}^h$ and equalizes consumption levels: $c_{1FB}^l = c_{1FB}^h$, $c_{2FB}^l = c_{2FB}^h$, $g_{2FB}^l = g_{2FB}^h$ and $t_{1FB}^l = t_{1FB}^h$, $t_{2FB}^l = t_{2FB}^h$. (first best)

Proof. (16) results in $g_{2FB}^l = g_{2FB}^h$. Combining (15) and (16) with (8) and (9) results in $c_{1FB}^l = c_{1FB}^h$, $c_{2FB}^l = c_{2FB}^h$ and $t_{1FB}^l = t_{1FB}^h$, $t_{2FB}^l = t_{2FB}^h$. With $\theta^h < \theta^l$, this leads to $b_{FB}^l > b_{FB}^h$ and $m_{FB}^h < 0 < m_{FB}^l$. ■

The term (15) affirms the argument of Barro (1979) and Lucas and Stokey (1983). The issuance of public debt enables governments to shift the financial burden, resulting from the exogenous shock, from one to the other period and thus to smooth public consumption over two periods. The redistributional transfer scheme serves to equalize public consumption between the regions in the second period (term (16)). In the simplified case $n^h = n^l$, it takes the form $m_{FB}^l = \frac{1}{2}\left(b_{FB}^l - b_{FB}^h\right)(1+r) = -m_{FB}^h$. We can see that the excessive debt burden is spread evenly among the regions. Hence, all regions realize the same tax rates and the same private consumption in the two periods.

3.3 Optimal grants under asymmetric information

Given this transfer scheme, the agents are inclined to deviate from their strategy if information is asymmetrically distributed between the principal and the agents. This behaviour can be visualized by the indifference curve of the agents which is defined by the marginal rate of substitution between borrowing and grant:

$$\left.\frac{dm}{db}\right|_{dV=0} = -\frac{\theta u_1'(g_1) - u_2'(g_2)(1+r)}{u_2'(g_2)} \tag{17}$$
$$\left.\frac{d^2m}{db^2}\right|_{dV=0} = -\frac{\theta u_1''(\cdot)\, u_2'(\cdot) + \theta u_1'(\cdot)\, u_2''(\cdot)(1+r)}{\left[u_2'(\cdot)\right]^2} > 0 \tag{18}$$

It provides all combinations of m and b where indirect utility of the agent is constant. Its curvature is u-shaped. The minimum is reached, when the public debt is optimally allocated according to the first order condition (15) ($\partial V/\partial b = 0$). If borrowing is too low ($\partial V/\partial b > 0$) or too high ($\partial V/\partial b < 0$), the region is faced with the loss of utility. In this case, the agent can realize a constant utility level, if he is compensated by higher transfer payments. Due to $\frac{\partial(\partial V/\partial b)}{\partial m} > 0$, the minimum point moves upward to the right. Given a higher transfer payment, the region would reach a higher utility if it took up higher public debt corresponding to (15).

Differentiating (17) by θ entails

$$\frac{\partial}{\partial \theta}\left(\frac{dm}{db}\right) = -\frac{u_1'(\cdot)}{u_2'(\cdot)} - \frac{\theta u_1''(\cdot)}{u_2'(\cdot)}\frac{dt}{d\theta} = -\frac{u_1'(\cdot)}{u_2'(\cdot)}\left[1 - \frac{\theta u_1''(\cdot)}{w_1''(\cdot) + \theta u_1''(\cdot)}\right] < 0. \tag{19}$$

(19) demonstrates that the slope of the indifference curve of the poor is smaller than that of the rich. This means that type l benefits more from an additional transfer payment relative to public borrowing than type h. This attribute represents the Spence-Mirlees-Single-Crossing-Property.[7] It assures that a mechanism can be set up which induces different types to choose different strategies.

Under asymmetric information, the first best transfer system would stimulate the rich region to mimic the poor. Due to the argument above, type h would realize a higher utility level, if it picked the contract of type l $\left(b^l_{FB}, m^l_{FB}\right)$ instead of $\left(b^h_{FB}, m^h_{FB}\right)$. To make regions reveal their true types, the principal has to secure that I.C.1 and I.C.2. are fullfilled. Then, the optimal grant scheme exhibits the following characteristics:

Proposition 2 *Under asymmetric information the incentive compatible transfer scheme conditioned on debt policy is defined by*

$$\theta^h u_1'\left(g^h_{1B}\right) = u_2'\left(g^h_{2D}\right)(1+r) \tag{20}$$

$$\theta^l u_1'\left(g^l_{1B}\left(\theta^l\right)\right) < u_2'\left(g^l_{2D}\right)(1+r) \tag{21}$$

$$u_2'\left(g^l_{2B}\right) > u_2'\left(g^h_{2B}\right). \tag{22}$$

Contributing regions realize an efficient debt level whereas recipient regions implement an inefficient high debt level. They receive inefficient low transfers. The transfer system, defined by $m^h_B < 0 < m^l_B$ *and* $b^h_{1B} < b^l_{1B}$*, does not equalize*

[7] For further explanations, see Fudenberg and Tirole (2000), p. 259f. and Bolton and Dewatripont (2005), p. 54 and 78.

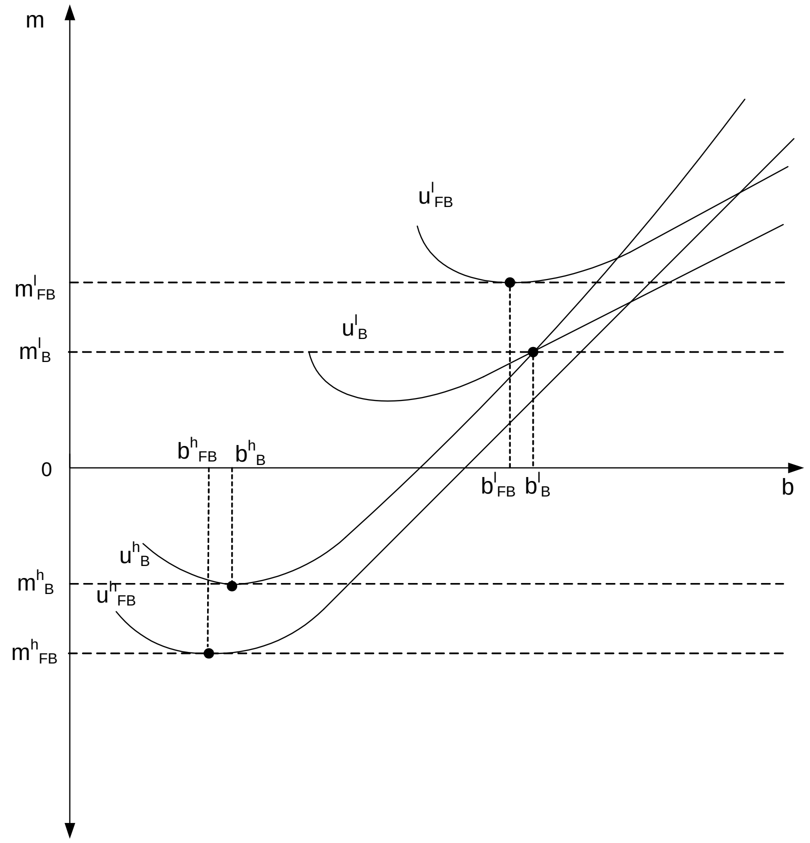
public good levels in the second period and private consumption which leads to $g^h_{2B} > g^l_{2B}$*,* $c^h_{2B} > c^l_{2B}$*,* $c^h_{1B} > c^l_{1B}$ *and* $t^h_{1B} < t^l_{1B}$*,* $t^h_{2B} < t^l_{2B}$*.*[8]

Proof. The proof is given in the appendix. ■

According to (20) and (21), the contract system satisfies the principle of no distortion at the top and distortion at the bottom, which screening devices reveal under asymmetric information. In order to deter type h from mimicking type l, type l has to implement an inefficient high debt level whereas type h borrows efficiently. The term (22) shows that marginal utility of public consumption is not equalized between the regions. The poor region has to renounce transfers, leaving the rich region an informational rent and thus more private and public consumption.

Figure 1 illustrates the first best and second best allocations under the assumption $n^h = n^l$. In the first best case, both regions realize their optimal allocation in

Figure 1: Intergovernmental grants intervening into debt policy



the minimum of the indifference curve. The rich region pays a lump sum transfer $m^h_{FB} = -m^l_{FB}$ to the poor region and takes up less public debt ($b^h_{FB} < b^l_{FB}$). In

[8]Subscript B describes the case of intervention into debt policy.

the face of asymmetric information, the first best solution is not achieved. In order to realize a higher utility level, the rich region would pick the contract of the poor region $\left(b^l_{FB}, m^l_{FB}\right)$ instead of $\left(b^h_{FB}, m^h_{FB}\right)$. Hence, through the second best transfer system $\left\{\left(b^h, m^h\right), \left(b^l, m^l\right)\right\}$, the utilities of the types are changed in such a way that the regions choose the public debt level destined to their type. From the figure we can see that the second best solution leaves the rich region better off and the poor region worse off compared to the first best solution. The rich region realizes its optimum in the minimum of the indifference curve lying above the first best curve. It chooses the debt b^h_B, pays less transfers m^h_B and realizes a higher utility u^h_B than in the first best case. The poor region has to abstain from transfers and has to expand public borrowing to an inefficient level b^l_B. Its contract is found on the increasing part of the indifference curve u^l_B, which lies below the first best curve. Both contracts restore incentive compatibility. The low region would realize a lower utility level if it chose the contract of the rich. The rich region is indifferent between $\left(b^l_B, m^l_B\right)$ and $\left(b^h_B, m^h_B\right)$.

The reason why the rich region slightly prefers to borrow little and to pay a contribution to the transfer system than to run into excessive debt and to receive grants is revealed by the curvature of the indifference curves. In figure 1, we can see that among the rich a marginal deviation from the optimal level of public debt must be compensated by a higher transfer to achieve equal utility than among the poor. So, the fiscal policy $\left(b^l_B, m^l_B\right)$ is more inefficient for the rich than for the poor which reduces the incentive of the rich to deter from truthful relevation. Allocative inefficiency constitutes a trade-off with unequal distribution, as is evident in the following proposition:

Proposition 3 *In the case $n^h = n^l = 1$, the incentive compatible grant scheme conditioned on public debt is defined by*

$$u_2'\left(g^h_{2B}\right) = \frac{\left(1-\lambda^h_B\right)}{\left(1+\lambda^h_B\right)} u_2'\left(g^l_{2B}\right) \ \ \textit{with} \ \lambda^h_B = \frac{u_2'\left(g^l_{2B}\right)(1+r) - \theta^l u_1'\left(g^l_{1B}\left(\theta^l\right)\right)}{u_2'\left(g^l_{2B}\right)(1+r) - \theta^h u_1'\left(g^l_{1B}\left(\theta^h\right)\right)} \tag{23}$$

or

$$\frac{u_2'\left(g^h_{2B}\right)}{u_2'\left(g^l_{2B}\right)} = \frac{\theta^l u_1'\left(g^l_{1B}\left(\theta^l\right)\right) - \theta^h u_1'\left(g^l_{1B}\left(\theta^h\right)\right)}{2u_2'\left(g^l_{2B}\right)(1+r) - \theta^h u_1'\left(g^l_{1B}\left(\theta^h\right)\right) - \theta^h u_1'\left(g^l_{1B}\left(\theta^h\right)\right)}. \tag{24}$$

The transfer system equalizes the effects of unequal distribution with the relative difference in allocative inefficiency between type l and type h, if both picked $\left(m^l, b^l\right)$.

Proof. The proof is given in the appendix. ■

The terms (23) and (24) reveal that the allocative inefficiency and distributive inequality of the transfer systems are interdependent factors. The first term in (23) reflects the effect of the informational rent on local public consumption. The higher λ_B^h, the shadow price of the self selection constraint, the higher is the difference between the marginal utilities of public consumption. λ_B^h is equal to the term on the right hand side, the (negative) marginal utility of public debt between the rich and the poor if both pick $\left(b_B^l, m_B^l\right)$. Due to the argument above, a marginal increase in b_B^l (and holding constant m_B^l) generates higher efficiency losses for the rich than for the poor. The more inefficient the debt policy in the poor region, the lower is the difference between $u_2'\left(g_{2B}^h\right)$ and $u_2'\left(g_{2B}^l\right)$, and the lower is the informational rent given to type h. Consequently, distorting the public debt level of type l serves to reduce the informational rent for type h.

From (23) and (24) we can also see that the welfare losses of the transfer system are determined by the difference of the regions in the size of the shock. The higher the difference of marginal ultility of public borrowing between the two types, the lower is the difference between $u_2'\left(g_{2B}^h\right)$ and $u_2'\left(g_{2B}^l\right)$. Therefore, the less similar the rich and the poor region, the lower is the incentive of the rich to defect from truthful relevation, and the lower is its informational rent.

4 Grants intervening into tax policy

4.1 Optimal grants under full information

The case of intervention into tax policy is characterized by the following procedure: (1) The central government defines two contracts in which transfer payments are conditioned on the tax policy of the local governments $\left\{\left(m^h, t_1^h, t_2^h\right), \left(m^l, t_1^l, t_2^l\right)\right\}$.
(2) Local governments pick one of the two contracts by choosing the corresponding tax rates t_1^k, t_2^k and decide autonomously on debt policy b^k.

Solving by backward induction, indirect utility is defined ex post by local government optimization respective b^k:

$$\begin{aligned} & V\left(t_1, t_2, m, \theta\right) && (25) \\ = \quad & \max_b \left\{w_1\left(\left(1-t_1\right) y\right) + \theta u_1\left(b + t_1 y\right) + w_2\left(1 - t_2 y\right) + u_2\left(y t_2 - b\left(1+r\right) + m\right)\right\} \end{aligned}$$

Local governments choose public debt so that[9]

$$b_T \in \theta u_1'(g_1) = u_2'(g_2)(1+r). \tag{26}$$

$b_T = b_T(t_1, t_2, m, \theta)$ is a function of t_1, t_2, m and θ and defined by $\frac{db}{dt_1} = -\frac{\theta_1 u_1''(\cdot)y}{u_1''(\cdot)+u_2''(\cdot)(1+r)^2} < 0$, $\frac{db}{dt_2} = \frac{u_2''(\cdot)y(1+r)}{u_1''(\cdot)+u_2''(\cdot)(1+r)^2} > 0$, $\frac{db}{dm} = \frac{u_2''(\cdot)(1+r)}{u_1''(\cdot)+u_2''(\cdot)(1+r)^2} > 0$, $\frac{db}{d\theta} = -\frac{u_1'(\cdot)}{\theta u_1''(\cdot)+u_2''(\cdot)(1+r)^2} > 0$. The welfare maximization problem of the central government reads

$$\max_{\left\{t_1^k, t_2^k, m^k\right\}_{k\in\{h,l\}}} \sum_k n^k V\left(t_1^k, t_2^k, m^k, \theta^k\right) \tag{27}$$
$$s.t\ (6)$$

$$I.C.1 \ : \ V\left(t_1^h, t_2^h, m^h, \theta^h\right) \geq V\left(t_1^l, t_2^l, m^l, \theta^h\right) \tag{28}$$
$$I.C.2 \ : \ V\left(t_1^l, t_2^l, m^l, \theta^l\right) \geq V\left(t_1^h, t_2^h, m^h, \theta^l\right), \tag{29}$$

where I.C.1 and I.C.2 are the incentive constraints for the high and low type regions. Using the Envelope Theorem, we get the first order conditions

$$\left(n^h + \lambda_T^h\right)\left[w_1'\left(c_{1T}^h\right) - \theta^h u_1'\left(g_{1T}^h\right)\right] = \lambda_T^l\left[w_1'\left(c_{1T}^h\right) - \theta^l u_1'\left(g_1\left(t_{1T}^h, b_T\left(\theta^l\right)\right)\right)\right] \tag{30}$$
$$\left(n^h + \lambda_T^h\right)\left[w_2'\left(c_{2T}^h\right)y - u_2'\left(g_{2T}^h\right)\right] = \lambda_T^l\left[w_2'\left(c_{2T}^h\right) - u_2'\left(g_2^h\left(t_{2T}^h, b_T\left(\theta^l\right)\right)\right)\right] \tag{31}$$
$$\left(n^l + \lambda_T^l\right)\left[w_1'\left(c_{1T}^l\right) - \theta^l u_1'\left(g_{1T}^l\left(\theta^l\right)\right)\right] = \lambda_T^h\left[w_1'\left(c_{1T}^l\right) - \theta^h u_1'\left(g_{1T}^l\left(\theta^h\right)\right)\right] \tag{32}$$
$$\left(n^l + \lambda_T^l\right)\left[-w_2'\left(c_{2T}^l\right) + u_2'\left(g_{2T}^l\left(\theta^l\right)\right)\right] = \lambda_T^h\left[w_2'\left(c_{2T}^l\right) - u_2'\left(g_{2T}^l\left(\theta^h\right)\right)\right] \tag{33}$$
$$\left(1 + \frac{\lambda_T^l}{n^l}\right)u_2'\left(g_{2T}^l\right) - \frac{\lambda_T^h}{n^l}u_2'\left(g_{2T}^l\left(\theta^h\right)\right) = \left(1 + \frac{\lambda_T^h}{n^h}\right)u_2'\left(g_{2T}^h\right) - \frac{\lambda_T^l}{n^h}u_2'\left(g_{2T}^h\left(\theta^l\right)\right), \tag{34}$$

where λ_T^h and λ_T^l are the Lagrange multipliers of I.C.1 and I.C.2. For reasons of convenience, we use $g_{1T}^l\left(\theta^l\right) = b_T\left(\theta^l\right) + t_{1T}^l y$, $g_{1T}^l\left(\theta^h\right) = b_T\left(\theta^h\right) + t_{1T}^l y$, $g_{2T}^l\left(\theta^l\right) = t_{2T}^l y - (1+r)b_T\left(\theta^l\right) + m_T^l$, $g_{2T}^l\left(\theta^h\right) = t_{2T}^l y - (1+r)b_T\left(\theta^h\right) + m_T^h$.

We assume that I.C.1 and I.C.2 are not binding ($\lambda_T^h = \lambda_T^l = 0$) if information about the shocks is verifiable. This leads to Proposition 1. Under full information transfer systems conditioned on local tax policy entail the same allocation as transfer systems conditioned on debt policy. As already shown, all regions implement identical tax rates in the first and second period $t_{1FB}^h = t_{1FB}^l$, $t_{2FB}^h = t_{2FB}^l$. It is obvious, that this kind of transfer system leads to misallocation, when the size of

[9] Subskript T defines the case of intervention into local tax policy.

shock is not observable. If the transfer system is conditioned on these tax rates, the principal will not be able to differentiate between the types.

4.2 Optimal grants under asymmetric information

Under asymmetric information, the central government offers a contract menue that seperates the two types:

Proposition 4 *Under asymmetric information the incentive compatible transfer scheme conditioned on local tax policy is defined by*

$$w_1'\left(c_{1T}^h\right) = \theta^h u_1'\left(g_{1T}^h\right), \; w_2'\left(c_{2T}^h\right) = u_2'\left(g_{2T}^h\right) \tag{35}$$

$$w_1'\left(c_{1T}^l\right) > \theta^l u_1'\left(g_{1T}^l\left(\theta^l\right)\right), \; w_2'\left(c_{2T}^l\right) > u_2'\left(g_{2T}^l\left(\theta^l\right)\right) \tag{36}$$

$$u_2'\left(g_{2T}^l\left(\theta^l\right)\right) > u_2'\left(g_{2T}^h\left(\theta^h\right)\right). \tag{37}$$

Contributing regions realize efficient tax rates in both periods whereas recipient regions implement inefficient high tax rates. They receice inefficient low transfers. The transfer system is given by $m_T^h < 0 < m_T^l$, $t_{1T}^h < t_{1T}^l$ *and* $t_{2T}^h < t_{2T}^l$*. It does not equalize public good levels in the second period and private consumption* $g_{2T}^h > g_{2T}^l$, $c_{1T}^h > c_{1T}^l$, *and* $c_{2T}^h > c_{2T}^l$ *with* $b_T^h < b_T^l$*.*

Proof. The proof is given in the appendix. ■

The contract system $\left\{\left(m^h, t_1^h, t_2^h\right), \left(m^l, t_1^l, t_2^l\right)\right\}$ assignes different tax rates to the poor and rich regions. The proposition shows that, unlike the tax policy of the rich region, the tax policy of the poor region is distorted. Type l has to choose inefficient high tax rates in both periods. For this reason, the poor region is forced to provide an inefficient high amount of public goods in both periods at the expense of private consumption. As in the former case, the grant scheme does not equalize marginal utility of the high and the low type, leaving the rich region with an informational rent and higher private and public consumption in the second period.

5 Grants intervening into complete fiscal policy

5.1 Optimal grants under full information

The last option of the government is to intervene completely into local fiscal policy. This means:

(1) The central government conditions transfer payments on tax rates and public

debt. It offers the contract menue $\left\{\left(m^h, t_1^h, t_2^h, b^h\right), \left(m^l, t_1^l, t_2^l, b^l\right)\right\}$.
(2) Local governments decide on one of the two contracts by choosing $q^h = \left(t_1^h, t_2^h, b^h\right)$ or $q^l = \left(t_1^l, t_2^l, b^l\right)$.

The optimization problem of the central government is given by maximization of the sum of utilities subject to the local and to the central budget constraints and the self selection constraints:

$$\begin{aligned} &\max_{\left\{m^k, b^k, t_1^k, t_2^k\right\}_{k\in\{h,l\}}} \sum_k n^k U\left(\theta^k, q^k, m^k\right) \\ &s.t.(2), (3), (4), (5), (6) \end{aligned} \tag{38}$$

$$\begin{aligned} I.C.1 &: U\left(q^h, m^h\right) \geq U\left(q^l, m^l\right) \\ I.C.2 &: U\left(q^l, m^l\right) \geq U\left(q^h, m^h\right) \end{aligned}$$

Under full information the optimal transfer scheme intervening into complete fiscal policy satisfies the same conditions as the ones intervening into debt and tax policy:

$$\begin{aligned} w_1'\left(c_{1FB}^h\right) &= \theta^h u_1'\left(g_{1FB}^h\right) = w_2'\left(c_{2FB}^h\right)(1+r) = u_2'\left(g_{2FB}^h\right)(1+r) = \\ w_1'\left(c_{1FB}^l\right) &= \theta^l u_1'\left(g_{1FB}^l\right) = w_2'\left(c_{2FB}^l\right)(1+r) = u_2'\left(g_{2FB}^l\right)(1+r) \end{aligned} \tag{39}$$

Complete equalization of the marginal rates of consumption between public and private goods within one period, between regions and between periods is achieved.

5.2 Optimal grants under asymmetric information

As already shown in section 3, the grant system would animate the rich region to choose excessive public debt levels, if information about the exogenous shocks cannot be verified by the central government. In order to solve the adverse selection problem, the optimal transfer system has to exhibit the following characteristics:

Proposition 5 *Under asymmetric information the incentive compatible transfer scheme intervening into complete fiscal policy is defined by*

$$\theta^h u_1'\left(g_{1F}^h\right) = u_2'\left(g_{2F}^h\right)(1+r), \theta^h u_1'\left(g_{1F}^h\right) = w_1'\left(c_{1F}^h\right), \; u_2'\left(g_{2F}^h\right) = w_2'\left(c_{2F}^h\right) \tag{40}$$

$$\theta^l u_1'\left(g_{1F}^l\right) < u_2'\left(g_{2F}^l\right)(1+r), \; \theta^l u_1'\left(g_{1F}^l\right) < w_1'\left(c_{1F}^l\right), \; w_2'\left(c_{2F}^l\right) = u_2'\left(g_{2F}^l\right) \tag{41}$$

$$u_2'\left(g_{2F}^h\right) < u_2'\left(g_{2F}^l\right). \tag{42}$$

Contributing regions realize an efficient debt level and efficient tax rates. Recipient regions implement an inefficient high debt level and an inefficient tax rate in the first period and realize an efficient tax rate in the second period. They receice inefficient low transfers. The transfer system is given by $m_F^h < 0 < m_F^l$, $b_{1F}^h < b_{1F}^l$, $t_{1F}^h < t_{1F}^l$ *and* $t_{2F}^h < t_{2F}^l$. *It does not equalize public good levels in the second period and private consumption* $g_{2F}^h > g_{2F}^l$, $c_{2F}^h > c_{2F}^l$ *and* $c_{1F}^h > c_{1F}^l$.[10]

Proof. The proof is given in the appendix. ■

With regard to condition (40), the choice of $\left(b_F^h, t_{1F}^h, t_{2F}^h\right)$ is optimal for the rich region whereas $\left(b_F^l, t_{1F}^l, t_{2F}^l\right)$ is an inefficient allocation. The terms in (41) suggest that the debt level and the tax rate in the first period are set too high. The tax rate in the second period is undistorted. The rich region is indifferent between the vector $q_F^h = \left(b_F^h, t_{1F}^h, t_{2F}^h\right)$ and $q_F^l = \left(b_F^l, t_{1F}^l, t_{2F}^l\right)$, if it will be compensated by a lower transfer payment $m_F^l > m_F^h$, which is expressed by (42). As before, income is unequally redistributed between the low and the high type as low type.

6 Comparison of the alternative grant schemes

Having analysed the different transfer schemes, we have to identify which one the central government would choose in the first step. The principal picks the transfer system that entails the least welfare losses compared to the first best case. All three mechanisms reveal that grants are too low so that marginal utility is not equalized between the different types. The choice of q^l entails two kind of inefficiencies for type l. In section 3, interregional public and private consumption is distorted. The case in section 4 results in an oversupply of public goods and an undersupply of private goods in both periods. In section 5, first period public consumption is too high relative to the second period public consumption and the first period private consumption.

Like Jack (2005), we cannot quantify the distortionary costs or the extent of the welfare losses of the three grant schemes. Instead, we compare them regarding the common first order constraints in the simplifying case $n^l = n^h = 1$. Constraining

[10] Subscript F describes the case of intervention into debt policy.

borrowing autonomy (case B) results in

$$
\begin{aligned}
u_2'\left(g_{2B}^h\right) &= \frac{\left(1-\lambda_B^h\right)}{\left(1+\lambda_B^h\right)}u_2'\left(g_{2B}^l\right) \qquad (43)\\
\text{with } \lambda_B^h &= \frac{u_2'\left(g_{2B}^l\right)(1+r)-\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right)}{u_2'\left(g_{2B}^l\right)(1+r)-\theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right)},
\end{aligned}
$$

constraining tax autonomy (case T) results in

$$
\begin{aligned}
u_2'\left(g_{2T}^h\right) &= \frac{u_2'\left(g_{2T}^l\right)-\lambda_T^h u_2'\left(g_{2T}^l\left(\theta^h\right)\right)}{\left(1+\lambda_T^h\right)} \qquad (44)\\
\text{with } \lambda_T^h &= \frac{w_1'\left(c_{1T}^l\right)-\theta^l u_1'\left(g_{1T}^l\left(\theta^l\right)\right)}{w_1'\left(c_{1T}^l\right)-\theta^h u_1'\left(g_{1T}^l\left(\theta^h\right)\right)}=\frac{w_2'\left(c_{2T}^l\right)-u_2'\left(g_{2T}^l\left(\theta^l\right)\right)}{w_2'\left(c_{2T}^l\right)-u_2'\left(g_{2T}^l\left(\theta^h\right)\right)},
\end{aligned}
$$

and constraining full financial autonomy (case F) results in

$$
\begin{aligned}
u_2'\left(g_{2F}^h\right) &= \frac{\left(1-\lambda_F^h\right)}{\left(1+\lambda_F^h\right)}u_2'\left(g_{2F}^l\right) \qquad (45)\\
\text{with } \lambda_F^h &= \frac{w_1'\left(c_{1F}^l\right)-\theta^l u_1'\left(g_{1F}^l\right)}{w_1'\left(c_{1F}^l\right)-\theta^h u_1'\left(g_{1F}^l\right)}=\frac{u_2'\left(g_{2F}^l\right)(1+r)-\theta^l u_1'\left(g_{1F}^l\right)}{u_2'\left(g_{2F}^l\right)(1+r)-\theta^h u_1'\left(g_{1F}^l\right)}.
\end{aligned}
$$

From the terms (43), (44) and (45), we can show

Proposition 6 *Incentive compatible transfer systems which intervene fully into local public policy making generate lower welfare losses than transfer systems that intervene partially into local fiscal policy (debt or tax policy) making.*

Proof. Proof is given in the appendix. ■

If we assume that distortion of the fiscal q^l are identical across the three cases, we can see that the rich region realizes lower efficiency losses under partial intervention than under full intervention when it picks the contract menue of the poor region. The rich region would choose a lower tax rate in case B than in case F, or choose lower debt in case T than in case F. Due to (43), (44) and (45), the difference of marginal utility of local public goods in the second period between rich and poor is bigger under partial intervention. Thus, the rich region has to receive a higher informational rent under partial than under full intervention.

The same argument can be applied if we assume equal distributive inequalities between rich and poor and regard different distortion effects. The poor region has to realize higher inefficiencies on choosing his fiscal policy under partial than under full intervention. In case B, the rich region has the possibility to adapt its fiscal policy to the given transfer system and thus to circumvent partially the distortive effects in the case of defection. If it chose the contract menue of the poor region for a given b^l, it would realize less inefficiencies than in case F. We can conclude that optimal transfer system must generate more allocative inefficiencies and more distributive inequalities under partial than under full intervention in order to avoid adverse selection.

The comparison of transfer mechanisms intervening into tax and into debt policy does not show clear results. These depend on the reaction of local policy to the conditional transfer system.

Proposition 7 *If public debt is more increased than tax income by an increase of the exogenous shock* $\left(\frac{db}{d\theta} > \frac{dt_1}{d\theta}y\right)$*, incentive compatible grant systems intervening into debt policy generate fewer welfare losses than grant systems intervening into tax policy.*

Proof. Proof is given in the appendix. ■

If the increase in θ leads to a higher change in public debt than in tax income $\left(\frac{db}{d\theta} > \frac{dt_1}{d\theta}y\right)$, the rich region will realize a lower marginal utility level, i.e. a higher rate of public consumption in case B than in case T. Then, intervention into tax autonomy causes higher distortion effects between rich and poor than intervention into borrowing autonomy.

In conclusion, the inefficiency of fiscal policy and suboptimal distributive effects between rich and poor are determined by the fact, in how far the rich region can circumvent the requirements of the transfer system. The smaller the possibility of the region to adjust local policy to the inefficient transfer system, the less the rich region is inclined to deviate from truthful revelation. The analysis has shown that in case F an inefficient fiscal policy of the poor region leads in itself to a higher distortion of the rich region picking the policy of the poor than in case B and T. Type l must be less distorted and type h less compensated for his informational advantage in order to guarantee incentive compatibility. This means: the more the grants are conditioned on different fiscal parameters, and the less the local government is flexibile to adjust its fiscal policy to regulation, the smaller are the welfare losses of the grant scheme.

7 Discussion

The analysis has shown different variants of incentive compatible transfer schemes under asymmetric information. Intergovernmental grants that serve to reduce local debt burden caused by exogenous shocks have to be conditioned on local fiscal policies. Subnational governments which are better off should not be inclined to raise public debts and demand additional grants. Grants that are conditioned on local debt level stipulate excessive debt levels of the recipient regions. Grants that allow intervention into tax policy demand inefficient high tax rates from the poor regions. Regulation of all fiscal parameters makes recipient regions choose an inefficient fiscal policy in the period of the exogenous shock. The comparison of the three alternative schemes reveals that fully restrictive grant schemes are to be prefered to partial restrictive ones. The more constraints are imposed on local fiscal autonomy, the less inefficient is the optimal transfer system. This is due to the fact that the local policy of the rich regions mimicking the poor is more distorted by full intervention into fiscal autonomy than by partial intervention, which reduces its incentive to defect from truthful relevation.

However, a transfer system that constraints full financial autonomy conflicts with the constitutional right of local autonomy and self governance, which is for example guaranteed to municipalities in Germany. Following Huber and Runkel (2006), it can be argued that the conditions of incentive compatible transfer systems summarized in proposition 2, 3, 4 and 5 can be implemented by measures other than contracts. We can pursue the transfer policy in the German states Schleswig-Holstein and Baden Württemberg, where all regions contribute to fiscal equivalisation scheme. Additional grants (called "Fehlbetragszuweisungen" or "Bedarfszuweisungen") are paid to those regions that exhibit excessive public debts and have implemented spending cuts and certain tax rates. Thus, it is enough to prescribe the tax rate or public debt level of the regions that demand for additional transfers, leaving contributing regions free choice in all fiscal parameters. In this way, financial autonomy is secured for the paying regions, while financial autonomy of the recipient regions is confined.

Despite this argument, a transfer system that fully restricts fiscal policy of the recipient regions is probably not politically enforcable. It might be easier to implement transfer systems that intervene only partially into financial autonomy. The comparison between intervention into debt policy and tax policy has not shown clear results. Which of the transfer system involves the lowest efficiency losses depends on the inability of the region to respond to the regulative policy. The analysis in section 6 revealed that in the first case rich regions would reduce their tax rates and in the second case public debt. We can assume that in the political process tax rates are more difficult to adjust than public debt levels. In Germany, changes in tax policy have to pass through local parliament approval whereas debt reduction is always practicable. From this point of view, transfer systems that prescribe certain debt levels might entail lower efficiency losses than transfer systems that prescribe certain tax rates in order to be incentive compatible.

The argument for transfer systems regulating local debt policy can be critized in two aspects. Firstly, proposition 2 is mainly driven by the assumption that the utility in the period of borrowing is affected by the exogenous shock. Proposition 2 cannot be verified, if we shift the timing of the exogenous shock into the period of consolidation. Instead, the results are reversed. Huber and Runkel (2008) demonstrate that in this case incentive compatiblity is guaranteed, if poor regions are forced to inefficient low public debts. This point of criticism can be opposed by the fact that these assumptions do not display the characteristics of debt relief payments which are in focus of this paper. If we assume that shocks turn up in the second period and regions act rationally, poor regions would exhibit lower debt levels than rich regions. Then, transfers are paid to regions with lower debt levels than to regions with high debt levels. If we focus on grants, paid to reduce debt burden that stem from past exogenous shock, the self selection problem is solved by stipulating inefficient high debt levels. An inefficient fiscal policy of the poor is accompanied by much higher distortive effects for the rich. Poor regions raise their utility level by choosing inefficient debt level and receiving transfers, while the utility of the rich region is unaffected. Proposition 2 is in line with Beetsma and Jensen (2003) that model a redistributive stability and growth pact which is less tight in economic downturns. It allows poor regions to take up higher debt, but sanctions rich regions at low deficits.

The second criticism is that forcing poor regions to an increased debt level does not conform to budget balancing, often constitutionally required on state and municipal level. This argument can be opposed by means of alternative implementations. Following Huber and Runkel (2008), incentive compatible transfer systems that allow for intervention into debt autonomy have the same effect than transfer systems that allow for intervention into spending autonomy. Proposition 2 is fullfilled, if the central government conditions transfers on public expenses in both periods $\left\{\left(m^h, g_1^h, g_2^h\right), \left(m^l, g_1^l, g_2^l\right)\right\}$. We can show that in the first period poor regions should raise public spending in order to cope with additional demand, but in the period of consolidation, they have to cut public spending considerably.

From the analysis of this paper, we can deduct the following political implications. Grant schemes that serve to cope with the burden of past exogenous shocks can even in the presence of asymmetric information elicit adequate behaviour and induce governments to implement a solid budget policy. The postulate is that central government must fully commit to the transfer system ex ante and guarantee incentive compatibility. To avoid adverse selection, payments have to be confined to cases of extreme budget crisis and accompanied by measures that actually sanction local governments asking for additional grants. The analysis has shown that the more the fiscal parameters of recipient states are regulated by the transfer payment, the less the recipient states have to be forced to inefficient policies. The results support the municipal policy in the German states Schleswig-Holstein or Baden-Württemberg. In both states, the state government pay grants to highly indebted municipalities, but at the same time intervene into their municipal financial autonomy by requiring spending cuts, higher tax rates, and administrative reforms.

The transfer system analysed above should not be confused with bailouts or soft budget constraints which has been extensively studied in the last years.[11] The premise of the soft budget constraints problem is that central governments cannot ex ante commit to a transfer system. Local governments anticipate that the central government will adapt the grants to local fiscal policy, which provides an incentive to moral hazard. They might be inclined to influence transfer payments by opportunistic behaviour. The accumulation of excessive subnational budget deficits in many federations are ascribed to the problem of soft budget constraints. In Germany it culminated to the budgetary crisis of the city state Berlin, whose claim for additional supplementary grants was rejected by the Federal Constitutional Court in 2006. The results of our model are found in the verdict of Berlin. Transfers are only to be paid in extreme budget crisis and after all possible measures have been taken to overcome the situation. Conclusively, by the court decision, a transfers system has been implemented into jurisdiction that might deter the states from engaging in unsolid fiscal policies in the future.

[11] For the theoretical analysis of the problem of soft budget constraint see Wildasin (1997), Goodspeed (2002) and Breuillé et al. (2006) and for the empirical analysis see Rodden (2002), Pettersson-Lidbom and Dahlberg (2003) and Büttner and Wildasin (2006).

8 Appendix

Proof to Proposition 2:
We first assume that I.C.1 is binding which means that I.C.2 is not binding: $\lambda_B^h > 0,\ \lambda_B^l = 0$. Given (12), (13) and (14), we get

$$u_2'\left(g_{2B}^h\right)(1+r) = \theta^h u_1'\left(g_{1B}^h\right) \tag{46}$$

$$\left(n^l - \lambda_B^h\right) u_2'\left(g_{2B}^l\right)(1+r) = n^l\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right) - \lambda_B^h\theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right) \tag{47}$$

$$\left(1 - \frac{\lambda_B^h}{n^h}\right) u_2'\left(g_{2B}^l\right) = \left(1 + \frac{\lambda_B^h}{n^h}\right) u_2'\left(g_{2B}^h\right). \tag{48}$$

(47) leads to (21). From (48) we obtain (22). Since with (46) and (47), the first order condition implies $\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right) - \frac{\lambda_B^h}{n^l}\theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right) = \left(1 + \frac{\lambda_B^h}{n^h}\right)\theta^h u_1'\left(g_{1B}^h\right)$. This leads to $\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right) > \theta^h u_1'\left(g_{1B}^h\right)$ and according to (8) und (9) to $w_1'\left(c_{1B}^l\right) > w_1'\left(c_{1B}^h\right)$ and $w_2'\left(c_{2B}^l\right) > w_2'\left(c_{2B}^h\right)$ resulting in $t_{1B}^h < t_{1B}^l$, $t_{2B}^h < t_{2B}^l$, $c_{2B}^h > c_{2B}^l$, $c_{1B}^h > c_{1B}^l$, $g_{1B}^h > g_{1B}^l$ and $b_B^l > b_B^h$. $\theta^l > \theta^h$ entails $\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right) < u_2'\left(g_{2B}^l\right)(1+r)$.

$m_B^h < 0 < m_B^l$ is proven by I.C.1 and the curvature of the indifference curve. $\left(b_{1B}^h, m_B^h\right)$ and $\left(b_{1B}^l, m_B^l\right)$ lie on the same indifference curve of type h. $\left(b_{1B}^h, m_B^h\right)$ is realized in the minimum, $\left(b_{1B}^l, m_B^l\right)$ on the increasing branch. Combining (47) and (48) results in

$$\left[\theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right) - u_2'\left(g_{2B}^l\right)(1+r)\right] = \left[\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right) - u_2'\left(g_{2B}^l\right)(1+r)\right] \frac{\left[u_2'\left(g_{2B}^l\right) + u_2'\left(g_{2B}^h\right)\right]}{\left[u_2'\left(g_{2B}^l\right) - u_2'\left(g_{2B}^h\right)\right]}. \tag{49}$$

Due to $\left[\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right) - u_2'\left(g_{2B}^l\right)(1+r)\right] < 0, \left[u_2'\left(g_{2B}^l\right) + u_2'\left(g_{2B}^h\right)\right] > 0$ and $\left[u_2'\left(g_{2B}^l\right) - u_2'\left(g_{2B}^h\right)\right] > 0$ it must be $\left[\theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right) - u_2'\left(g_{2B}^l\right)(1+r)\right] < 0$. Thus $b_B^l > b_B^h$ and $nm_B^h = -nm_B^l$ imply $m_B^h < 0 < m_B^l$.

$\lambda_B^h > 0$ and $\lambda_B^l = 0$ is satisfied by proof of contradiction. If $\lambda_B^l > 0$ und $\lambda_B^h = 0$, the first order conditions would be

$$n^h\theta^h u_1'\left(g_1\left(\theta^h\right)\right) - \lambda^l\theta^l u_1'\left(g_1^h\left(\theta^l\right)\right) = \left[n^h - \lambda_B^l\right] u_2'\left(g_2^h\right)(1+r) \tag{50}$$

$$u_2'\left(g_{2B}^l\right)(1+r) = \theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right) \tag{51}$$

$$\left(1 - \frac{\lambda_B^l}{n^h}\right) u_2'\left(g_{2B}^h\right) = \left(1 + \frac{\lambda_B^l}{n^h}\right) u_2'\left(g_{2B}^l\right). \tag{52}$$

The rich region would realize $u_2'\left(g_{2B}^h\right)(1+r) < \theta^h u_1'\left(g_{1B}^h\right)$ and $u_2'\left(g_{2B}^h\right) > u_2'\left(g_{2B}^l\right)$. Due to $\frac{\partial(\partial V/\partial b)}{\partial m} > 0$, defection of the poor would mean negative transfers and lower debts, which results in lower utility. This conflicts with I.C.2, because indifference is not given. Consequently, we have $\lambda_B^l = 0$ and $\lambda_B^h > 0$.

Proof to Proposition 3:
Simplifying $n^h = n^l = 1$, the terms (47) and (48) entail the common first order condition:

$$u_2'\left(g_{2B}^h\right) = u_2'\left(g_{2B}^l\right)\frac{\left(1-\lambda_B^h\right)}{\left(1+\lambda_B^h\right)} \text{ with } \lambda_B^h = \frac{u_2'\left(g_{2B}^l\right)(1+r) - \theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right)}{u_2'\left(g_{2B}^l\right)(1+r) - \theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right)} \quad (53)$$

The higher b_B^l the more efficiency losses result for the rich than for the poor region. A marginal increase in b_B^l makes the denominator change to $u_2''\left(g_{2B}^l\right)(1+r)^2 - \theta^l u_1''\left(g_{1B}^l\left(\theta^l\right)\right)$ and the numerator change to $u_2''\left(g_{2B}^l\right)(1+r)^2 - \theta^h u_1''\left(g_{1B}^l\left(\theta^h\right)\right)$, if m_B^l is held constant and denominator and numerator are regarded seperately. Assume that $u_2''\left(g_{2B}^l\right)(1+r)^2 < \theta^l u_1''\left(g_{1B}^l\left(\theta^l\right)\right)$ and $u_2''\left(g_{2B}^l\right)(1+r)^2 < \theta^h u_1''\left(g_{1B}^l\left(\theta^h\right)\right)$, then $u_2''\left(g_{2B}^l\right)(1+r)^2 - \theta^h u_1''\left(g_{1B}^l\left(\theta^h\right)\right) > u_2''\left(g_{2B}^l\right)(1+r)^2 - \theta^l u_1''\left(g_{1B}^l\left(\theta^l\right)\right)$.

From (53) we get

$$\frac{u_2'\left(g_{2B}^h\right)}{u_2'\left(g_{2B}^l\right)} = \frac{\left[u_2'\left(g_{2B}^l\right)(1+r) - \theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right)\right] - \left[u_2'\left(g_{2B}^l\right)(1+r) - \theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right)\right]}{\left[u_2'\left(g_{2B}^l\right)(1+r) - \theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right)\right] + \left[u_2'\left(g_{2B}^l\right)(1+r) - \theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right)\right]}$$

or

$$\frac{u_2'\left(g_{2B}^h\right)}{u_2'\left(g_{2B}^l\right)} = \frac{\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right) - \theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right)}{2u_2'\left(g_{2B}^l\right)(1+r) - \theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right) - \theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right)}.$$

Proof to Proposition 4:
We assume $\lambda_T^l = 0$ and $\lambda_T^h > 0$. The first order conditions entail

$$\begin{aligned} w_1'\left(c_{1T}^h\right) &= \theta^h u_1'\left(g_{1T}^h\right),\ w_2'\left(c_{2T}^h\right) = u_2'\left(g_{2T}^h\right) && (54) \\ \left(n^l - \lambda_T^h\right) w_1'\left(c_{1T}^l\right) &= n^l \theta^l u_1'\left(g_{1T}^l\left(\theta^l\right)\right) - \lambda_T^h \theta^h u_1'\left(g_{1T}^l\left(\theta^h\right)\right) && (55) \\ \left(n^l - \lambda_T^h\right) w_2'\left(c_{2T}^l\right) &= n^l u_2'\left(g_{2T}^l\left(\theta^l\right)\right) - \lambda_T^h u_2'\left(g_{2T}^l\left(\theta^h\right)\right) && (56) \\ u_2'\left(g_{2T}^l\right) &= u_2'\left(g_{2T}^h\right) + \lambda_T^h\left[\frac{1}{n^l}u_2'\left(g_{2T}^l\left(\theta^h\right)\right) + \frac{1}{n^h}u_2'\left(g_{2T}^h\right)\right] && (57) \end{aligned}$$

With $\theta^h < \theta^l$ and (26) the terms (55) and (56) display (36). Due to (26) the last term (57) leads to (37). Inserting (26) in (57) and (56) and (54) in (57) entails $w_1'\left(c_{1T}^l\right) > w_1'\left(c_{1T}^h\right)$, $w_2'\left(c_{2T}^l\right) > u_2'\left(c_{2T}^h\right)$, $\theta^h u_1'\left(g_{1T}^h\right) < \theta^l u_1'\left(g_{1T}^l\right)$, and $u_2'\left(g_{2T}^l\left(\theta^l\right)\right) < u_2'\left(g_{2T}^l\left(\theta^l\right)\right)$, resulting in $c_{2T}^h > c_{2T}^l$, $c_{1T}^h > c_{1T}^l$ i.e. $t_{1T}^h < t_{1T}^l$, $t_{2T}^h < t_{2T}^l$, $g_{2T}^h > g_{2T}^l$. Analogous to the proof to proposition 2, $\lambda_T^l = 0$ and $\lambda_T^h > 0$ are satisfied by proof of contradiction. $m_T^h < 0 < m_T^l$ is defined by the u-shape of the indifference curve. If $\left(t_{1T}^h, m_T^h\right)$ or

$\left(t_{2T}^h, m_T^h\right)$ are in the minimum of the indifference curve of the rich region $\left(t_{1T}^l, m_T^l\right)$ or $\left(t_{2T}^l, m_T^l\right)$ have to be on the increasing branch. The shape of the indifference curves $\left.\frac{dm}{dt_1}\right|_{dV=0,dt_2=0}$ is defined by

$$\left.\frac{dm}{dt_1}\right|_{dV=0,dt_2=0} = -\frac{\left[\theta u_1'(\cdot) - w_1'(\cdot)\right] y}{u_2'(\cdot)} \tag{58}$$

$$\left.\frac{d^2m}{dt_1^2}\right|_{dV=0,dt_2=0} = -\frac{\left[\theta^h u_1''(\cdot) + w_1''(\cdot)\right] y^2}{u_2'(\cdot)} > 0 \tag{59}$$

$$\frac{\partial}{\partial\theta}\left(\frac{dm}{dt_1}\right) = -\frac{u_1'(\cdot)}{u_2'(\cdot)} + \frac{\theta u_1''(\cdot)\, u_2'(\cdot) + u_2''(\cdot)(1+r)\left[\theta u_1'(\cdot) - w_1'(\cdot)\right]}{\left[u_2'(\cdot)\right]^2}\frac{db}{d\theta}. \tag{60}$$

$\left.\frac{dm}{dt_2}\right|_{dV=0,dt_1=0}$ is defined by

$$\left.\frac{dm}{dt_2}\right|_{dV=0,dt_1=0} = -\frac{\left[u_2'(\cdot) - w_2'(\cdot)\right] y}{u_2'(\cdot)} \tag{61}$$

$$\left.\frac{d^2m}{dt_2^2}\right|_{dV=0,dt_1=0} = -\frac{\left[w_2''(\cdot)\, u_2'(\cdot) + w_2'(\cdot)\, u_2''(\cdot)\right] y^2}{\left[u_2'(\cdot)\right]^2} > 0 \tag{62}$$

$$\frac{\partial}{\partial\theta}\left(\frac{dm}{dt_2}\right) = \frac{w_2'(\cdot)\, u_2''(\cdot)(1+r)\, y}{\left[u_2'(\cdot)\right]^2}\frac{db}{d\theta} < 0. \tag{63}$$

Following Laffont and Martimort (2002, p. 56), an unique equilibrium will be achieved, if the Spence-Mirlees-Property and the monotonicity hold for each parameter. This property is achieved in (63). Refering to (60), we can show that the Spence-Mirlees-Property and montonicity constraint is fullfilled, if the curvature is constrained to the strategy space $\left\{t_1^h, t_1^l\right\}$. The curves have to intersect in $\left(t_1^l, m^l\right)$. Apart from the minimum point $\left(t_1^h, m^h\right)$ $\left.\frac{dm}{dt_1}\right|_{dV=0,dt_2=0}$ is strictly monotonicly increasing. Due to (35) and (36), the optimal point of the low type is situated on the increasing part of the indifference curve. Intersection of the curves in $\left(t_1^l, m^l\right)$ requires that $\frac{\partial}{\partial\theta}\left(\frac{dm}{dt_1}\right) < 0$ holds, and the minimum of type l must be situated on the right of $\left(t_1^h, m^h\right)$. The condition $\frac{\partial}{\partial\theta}\left(\frac{dm}{dt_1}\right) < 0$ is given, if we get

$$\begin{aligned} & -u_2'(\cdot)\left(u_1''(\cdot) + u_2''(\cdot)(1+r)^2\right) - u_2''(\cdot)\, w_1'(\cdot)(1+r) \\ > \; & -\theta u_1''(\cdot)\, u_2'(\cdot) + u_2''(\cdot)(1+r)\,\theta^h u_1'(\cdot). \end{aligned}$$

As we can assume $-u_2'(\cdot)\left(u_1'' + u_2''(1+r)^2\right) > -\theta u_1''(\cdot)\, u_2'(\cdot)$, $w_1'(\cdot) > \theta u_1'(\cdot)$,and $\theta \leq 1$, the Spence-Mirlees-Property is fulfilled. With $\frac{\partial(\partial U/\partial t_1)}{\partial m} = \theta u_1'' \frac{\partial b}{\partial m} < 0$ the minimum point of the indifference curve of the poor region is situated on the right, the one of the rich region on the left of the first best minimum point.

Proof to proposition 5:
The first order conditions of the optimization problem are

$$\left[\left(n^h+\lambda_F^h\right)\theta^h-\lambda_F^l\theta^l\right]u_1'\left(g_{1F}^h\right) = \left[\left(n^h+\lambda_F^h\right)u_2'\left(g_{2F}^h\right)-\lambda_F^l u_2'\left(g_{2F}^h\right)\right](1+r) \tag{64}$$

$$\left(n^h+\lambda_F^h-\lambda_F^l\right)w_1'\left(c_{1F}^h\right) = \left[\left(n^h+\lambda_F^h\right)\theta^h-\lambda_F^l\theta^l\right]u_1'\left(g_{1F}^h\right) \tag{65}$$

$$\left(n^h+\lambda_F^h-\lambda_F^l\right)w_2'\left(c_{2F}^h\right) = \left(n^h+\lambda_F^h\right)u_2'\left(g_{2F}^h\right)-\lambda_F^l u_2'\left(g_{2F}^h\right) \tag{66}$$

$$\left[\left(n^l+\lambda_F^l\right)\theta^l-\lambda_F^h\theta^h\right]u_1'\left(g_{1F}^l\right) = \left[\left(n^l+\lambda_F^l\right)u_2'\left(g_{2F}^l\right)-\lambda_F^h u_2'\left(g_{2F}^l\right)\right](1+r) \tag{67}$$

$$\left(n^l+\lambda_F^l-\lambda_F^h\right)w_1'\left(c_{1F}^l\right) = \left[\left(n^l+\lambda_F^l\right)\theta^l-\lambda_F^h\theta^h\right]u_1'\left(g_{1F}^l\right) \tag{68}$$

$$\left(n^l+\lambda_F^l-\lambda_F^h\right)w_2'\left(c_{2F}^l\right) = \left(n^l+\lambda_F^l\right)u_2'\left(g_2^l\right)-\lambda_F^h u_2'\left(g_{2F}^l\right) \tag{69}$$

$$\left(1+\frac{\lambda_F^h}{n^h}-\frac{\lambda_F^l}{n^h}\right)u_2'\left(g_{2F}^h\right) = \left(1+\frac{\lambda_F^l}{n^l}-\frac{\lambda_F^h}{n^l}\right)u_2'\left(g_{2F}^l\right). \tag{70}$$

Under full information, we assume $\lambda_F^h=\lambda_F^l=0$ leading to (39). Under asymmetric information, we assume $\lambda_F^l=0$ und $\lambda_F^h>0$. The first order conditions respective b_F^h, t_{1F}^h and t_{2F}^h entail

$$\theta^h u_1'\left(g_{1F}^h\right) = u_2'\left(g_{2F}^h\right)(1+r) \tag{71}$$

$$w_1'\left(c_{1F}^h\right) = \theta^h u_1'\left(g_{1F}^h\right) \tag{72}$$

$$w_2'\left(c_{2F}^h\right) = u_2'\left(g_{2F}^h\right). \tag{73}$$

respective b_F^h, t_{1F}^h and t_{2F}^h

$$\left(n^l\theta^l-\lambda^h\theta^h\right)u_1'\left(g_{1F}^l\right) = \left(n^h-\lambda^h\right)u_2'\left(g_{2F}^l\right)(1+r) \Longrightarrow \theta^l u_1'\left(g_{1F}^l\right) < u_2'\left(g_{2F}^l\right)(1+r) \tag{74}$$

$$\left(n^h-\lambda^h\right)w_1'\left(c_{1F}^l\right) = \left(n^l\theta^l-\lambda^h\theta^h\right)u_1'\left(g_{1F}^l\right) \Longrightarrow w_1'\left(c_{1F}^l\right) > \theta^l u_1'\left(g_{1F}^l\right) \tag{75}$$

$$\left(n^h-\lambda^h\right)w_2'\left(c_{2F}^l\right) = \left(n^h-\lambda^h\right)u_2'\left(g_{2F}^l\right) \Longrightarrow w_2'\left(c_{2F}^l\right) = u_2'\left(g_{2F}^l\right), \tag{76}$$

and respective m_F^l

$$\left(1+\frac{\lambda_F^h}{n^h}\right)u_2'\left(g_{2F}^h\right)=\left(1-\frac{\lambda_F^h}{n^h}\right)u_2'\left(g_{2F}^l\right)\Longleftrightarrow u_2'\left(g_{2F}^h\right)<u_2'\left(g_{2F}^l\right). \tag{77}$$

Inserting (75) and (76) in (74) results in

$$w_1'\left(c_{1F}^l\right)=w_2'\left(c_{2F}^l\right)(1+r)$$

For the rich region the menu $\left(b_F^h,t_{1F}^h,t_{2F}^h,m_F^h\right)$ is optimal. b_F^h is defined by (71). $b_F^h<b_F^l$ is given, as $\theta^h u_1'\left(g_{1F}^l\right)-u_2'\left(g_{2F}^l\right)(1+r)<0$ and $\theta^l u_1'\left(g_{1F}^l\right)-u_2'\left(g_{2F}^l\right)(1+r)<0$. $m_F^h<0<m_F^l$ can be derived from I.C.1. In order to realize a seperating equlibrium the single crossing property has to be fullfilled. According to Laffont and Martimort (2002), it is sufficient, if the property is met for the whole vector, not for each parameter. Due to $\frac{\partial}{\partial\theta}\left(\frac{dm}{db}\right)=-\frac{u_1'}{u_2'}$, $\frac{\partial}{\partial\theta^k}\left(\frac{dm}{dt_1}\right)=-\frac{u_1'(\cdot)}{u_2'(\cdot)}$, and $w_1'\left(c_{1F}^k\right)=w_2'\left(c_{2F}^k\right)(1+r)$ the single crossing property is fullfilled for the whole vector including t_2.

Proof of proposition 6

We assume that distortions of the fiscal policy q^l are identical:

$$\begin{aligned} u_2'\left(g_{2F}^l\right)(1+r)-\theta^l u_1'\left(g_{1F}^l\right) &= u_2'\left(g_{2B}^l\right)(1+r)-\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right) && (78)\\ w_1'\left(c_{1F}^l\right)-\theta^l u_1'\left(g_{1F}^l\right) &= w_1'\left(c_{1T}^l\right)-\theta^l u_1'\left(g_{1T}^l\left(\theta^l\right)\right) && (79)\end{aligned}$$

We get

$$\frac{u_2'\left(g_{2F}^l\right)(1+r)-\theta^l u_1'\left(g_{1F}^l\right)}{u_2'\left(g_{2F}^l\right)(1+r)-\theta^h u_1'\left(g_{1F}^l\right)}<\frac{u_2'\left(g_{2B}^l\right)(1+r)-\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right)}{u_2'\left(g_{2B}^l\right)(1+r)-\theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right)} \tag{80}$$

and

$$\frac{w_1'\left(c_{1F}^l\right)-\theta^l u_1'\left(g_{1F}^l\right)}{w_1'\left(c_{1F}^l\right)-\theta^h u_1'\left(g_{1F}^l\right)}<\frac{w'\left(c_{1T}^l\right)-\theta^l u_1'\left(g_{1T}^l\left(\theta^l\right)\right)}{w'\left(c_{1T}^l\right)-\theta^h u_1'\left(g_{1T}^l\left(\theta^h\right)\right)}. \tag{81}$$

This is due to the fact that regarding (80) the rich region realizes $g_{1B}^l\left(\theta^h\right)<g_{1F}^l$ and $\theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right)>\theta^h u_1'\left(g_{1F}^l\right)$. We get $u_2'\left(g_{2B}^l\right)(1+r)-\theta^h u_1'\left(g_{1B}^l\left(\theta^l\right)\right)<u_2'\left(g_{2F}^l\right)(1+r)-\theta^h u_1'\left(g_{1F}^l\right)$. The same argument can be applied for term (81): $\theta^h u_1'\left(g_1^l\left(\theta^h\right)\right)>\theta^h u_1'\left(g_1^l\right)\Longleftrightarrow\theta^h u_1'\left(g_{1T}^l\left(\theta^h\right)\right)-w'\left(c_{1T}^l\right)<\theta^h u_1'\left(g_{1F}^l\right)-w_1'\left(c_{1F}^l\right)$. We can derive a similar argument while regarding the different distortion effects and assuming equal distributive inequalities between rich and poor. Departing from (80) and (81), we achieve

$$\frac{u_2'\left(g_{2F}^l\right)(1+r)-\theta^l u_1'\left(g_{1F}^l\right)}{u_2'\left(g_{2F}^l\right)(1+r)-\theta^h u_1'\left(g_{1F}^l\right)} = \frac{u_2'\left(g_{2B}^l\right)(1+r)-\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right)}{u_2'\left(g_{2B}^l\right)(1+r)-\theta^h u_1'\left(g_{1B}^l\left(\theta^h\right)\right)} \tag{82}$$

$$\frac{w_1'\left(c_{1F}^l\right)-\theta^l u_1'\left(g_{1F}^l\right)}{w_1'\left(c_{1F}^l\right)-\theta^h u_1'\left(g_{1F}^l\right)} = \frac{w_1'\left(c_{1T}^l\right)-\theta^l u_1'\left(g_{1T}^l\left(\theta^l\right)\right)}{w_1'\left(c_{1T}^l\right)-\theta^h u_1'\left(g_{1T}^l\left(\theta^h\right)\right)}, \tag{83}$$

if $u_2'\left(g_{2F}^l\right)(1+r)-\theta^l u_1'\left(g_{1F}^l\right) > u_2'\left(g_{2B}^l\right)(1+r)-\theta^l u_1'\left(g_{1B}^l\left(\theta^l\right)\right)$ and $w_1'\left(c_{1F}^l\right)-\theta^l u_1'\left(g_{1F}^l\right) > w_1'\left(c_{1T}^l\right)-\theta^l u_1'\left(g_{1T}^l\left(\theta^l\right)\right)$.

Proof to Proposition 7:
Inserting (9) in (43) and (26) in (44), we receive

$$\lambda_B^h = \frac{w_2'\left(c_{2B}^l\right)(1+r)-\theta^l u_1'\left(b^l+t_1\left(\theta^l\right)y\right)}{w_2'\left(c_{2B}^l\right)(1+r)-\theta^h u_1'\left(b^h+t_1\left(\theta^h\right)y\right)} \tag{84}$$

$$\lambda_T^h = \frac{w_2'\left(c_{2T}^l\right)(1+r)-\theta^l u_1'\left(b\left(\theta^l\right)+t_1 y\right)}{w_2'\left(c_{2T}^l\right)(1+r)-\theta^h u_1'\left(b\left(\theta^h\right)+t_1 y\right)}. \tag{85}$$

We assume that the denominators of (84) and (85) are equal:

$$w_2'\left(c_2^l\right)(1+r)-\theta^l u_1'\left(b^l+t_1\left(\theta^l\right)y\right) = w_2'\left(c_{2B}^l\right)(1+r)-\theta^l u_1'\left(b\left(\theta^l\right)+t_1^l y\right)$$

A marginal increase in θ leads to the following change in utility of public goods in the first period

$$\partial\frac{\theta u_1'\left(b+t_1(\theta)y\right)}{\partial\theta} = u_1'(\cdot)+\theta u_1''(\cdot)\frac{dt_1}{d\theta}y \text{ with } \frac{dt_1}{d\theta} = -\frac{u_1'(\cdot)}{w_1''(\cdot)y+\theta u_1''(\cdot)y} \tag{86}$$

$$\partial\frac{\theta u_1'\left(b(\theta)+t_1 y\right)}{\partial\theta} = u_1'(\cdot)+\theta u_1''(\cdot)\frac{db}{d\theta} \text{ with } \frac{db}{d\theta} = -\frac{u_1'(\cdot)}{\theta u_1''(\cdot)+u_2''(\cdot)(1+r)^2}. \tag{87}$$

In how far the numerators differ, depends on $\frac{dt_1}{d\theta}y$ in the case B and $\frac{db}{d\theta}$ in the case T. Assume that $|w_1''| > |u_2''(\cdot)|(1+r)^2$ entailing $\frac{dt_1}{d\theta}y < \frac{db}{d\theta}$, we get $\partial\frac{\theta u_1'(b+t_1(\theta)y)}{\partial\theta} > \partial\frac{\theta u_1'(b(\theta)+t_1 y)}{\partial\theta}$. This implies $\theta^h u_1'\left(b^l+t_1\left(\theta^h\right)y\right) < \theta^h u_1'\left(b\left(\theta^h\right)+t_1 y\right)$ and $g_{1B}^l\left(\theta^h\right) > g_{1T}^l\left(\theta^h\right)$ leading to $w_2'\left(c_{2B}^l\right)(1+r)-\theta^h u_1'\left(b^l+t_1\left(\theta^h\right)y\right) > w_2'\left(c_{2T}^l\right)(1+r)-\theta^h u_1'\left(b\left(\theta^h\right)+t_1^l y\right)$.

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