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Welfare Financing: Grant Allocation and Efficiency

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Abstract Welfare is often administered locally, but financed through grants from the central government. This raises the question how the central government can prevent local governments from spending more than necessary. We analyze block grants used in The Netherlands, which depend on exogenous spending need determinants and are estimated from previous period welfare spending. We show that, although these grants give rise to perverse incentives by reducing the marginal costs of welfare spending, they are likely to be more efficient than a matching grant, and more equitable than a fixed block grant.

Keywords Block grant · Efficiency · Equity · Grant allocation · Welfare financing

JEL Classification H53 · H75 · H77 · I38

1 Introduction

In many countries, the payment of welfare benefits to the needy is a responsibility of subnational governments. Decentralization allows public services to be tailored to local preferences (Oates 1972), and may be more efficient (Hayek 1945) as knowledge of local circumstances is needed to successfully run a welfare program. However, decentralized finance of redistributive programs is likely to break down as a result of the

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migration patterns it brings about ('race to the bottom', see, e.g., Dahlberg and Edmark 2008). Thus, welfare is usually administered locally, but financed centrally. This raises the question as to how the center can induce local administrators to administer welfare efficiently in such a situation. In this paper, we interpret efficient administration as implementing programs to assist recipients in moving from welfare to work and carrying out fraud investigations in such a way that the number of welfare recipients is minimized: only those who truly need it receive a welfare benefit.[1] Thus, the policy question is: if the money for benefits is coming from elsewhere, what is to stop local administrators from being overly generous?

In the last decades, many countries have introduced some kind of welfare reform. Two important types of reform concern a change in financing (notably a shift from matching grants to block grants) and a decentralization of welfare policy (notably, of discretion over eligibility and welfare levels). The 1996 welfare reform in the US combines both types of reform. Within European countries, however, regional differences in welfare eligibility and benefit levels are much less—or not at all—tolerated. In this paper we focus on the case of a *uniform* welfare policy, where local government behavior can be controlled only by grant allocation.

One way to create incentives for efficiency is to provide local administrators with block grants (a fixed amount) rather than matching grants (grants tied in a fixed proportion to local jurisdictions' own contributions). However, the choice between matching grants and block grants involves a trade-off between efficiency and equity.[2] Matching grants are not efficient because they reduce the costs to the local government of an extra welfare beneficiary. They reduce the incentive of the local administration to minimize welfare dependency. On the other hand, matching grants are equitable because they guarantee that the central government shoulders an equal share of every local government's welfare burden. Jurisdictions with high welfare spending needs due to exogenous circumstances receive a larger grant. In contrast, block grants are efficient, as they do not lower the cost of additional welfare recipients. But this comes at a price, as there is generally no guarantee that the welfare burden of every local government is shared by the central government to the same extent. Block grant financing may force local governments in economically backward regions to spend considerable sums of money from their own resources on welfare, while jurisdictions in affluent regions may not need to spend all their grant money on welfare.

Welfare is an entitlement program; people who qualify cannot be denied welfare. The challenge is thus to develop a grant allocation method which is both (sufficiently) efficient and (sufficiently) equitable. The Dutch 2004 welfare reform attempts to do so by allocating block grants in such a way that municipalities which operate efficiently will not need to use own resources to finance welfare expenditures. At the same time, total grants add up to no more than forecasted aggregated welfare expenditures. Thus, the Dutch aim to enjoy the benefits of block grants, without the disadvantage associated

[1] Thus, we ignore technical inefficiency. Many municipalities contract out programs to help welfare recipients find work to private firms which operate in more than one municipality. Therefore, this assumption does not seem to be unduly unrealistic there.

[2] This is essentially the same as the trade-off between incentives and rent extraction, see Laffont and Martimort (2002, Chapter 2).

with them. Such an approach may also be relevant for other programs besides welfare, e.g., health or education programs.

This paper analyzes the relative efficiency of this type of grant design from a theoretical perspective. That is, we focus on efficiency, not equity. We show that the system has two weaknesses. In our framework, a local administrator balances marginal costs and benefits of welfare spending. As explained above, a matching grant is inefficient because it directly decreases marginal costs of welfare spending—and thus of working inefficiently—and thereby affects the efficiency choice of local administrators, leading to a higher level of inefficiency. A standard block grant does not have this problem, and neither does the Dutch grant. However, the Dutch system makes *future* grants depend on current expenditures and thereby effectively reduces the marginal costs of spending too. Thus, first, like a matching grant, it affects the local governments' inefficiency decision by influencing the balance between marginal costs and benefits. Second, the grant does not converge to the fair grant over time. The question then is how the Dutch style block grant compares to a matching grant in terms of efficiency.

The remainder of this paper is organized as follows. Section 2 discusses related literature in several fields. Section 3 presents more detailed information about the Dutch welfare grant allocation method. Section 4 describes and solves a model of the efficiency choice at the municipality level. Section 5 adds to this several types of grant allocation and studies their effects on efficiency. Section 6 concludes.

2 Related Literature

This paper is related to several strands of literature: those concerning welfare reform, intergovernmental grants, fiscal equalization, and optimal grants.

Analyses of *welfare reforms* often simultaneously deal with both a change in financing and a decentralization of discretion over welfare policy.[3] Moreover, empirical studies of the influence of financing arrangements typically do not discriminate between the effects on benefit levels, which do not concern us here, and on the number of recipients. An exception is Baicker (2005), who uses US data from 1948 to 1963 to separately estimate the effect of the match rate of the federal grant on welfare benefits per recipient and on the number of welfare recipients. For the former, she found a price elasticity of around −0.4; for the latter, an elasticity of around −0.3. Thus, a matching grant results in a higher number of welfare beneficiaries than a block grant, which has a match rate of zero.

That result is in line with the traditional theory of *intergovernmental grants*, where the differential effects of matching grants and block or lump-sum grants have been discussed extensively (for a review, see, e.g., Wildasin 1986; Oates 1972, 1999; or Bird and Smart 2002). The upshot of this theory is that a matching grant, by lowering the marginal cost of public services, has a greater stimulating effect on local spending than does a lump-sum grant of the same amount. Matching grants may be optimal if

[3] See, e.g., Chernick (1998), Ribar and Wilhelm (1999) and Blank (2002) for the US welfare reform of 1996, and Gilbert and Rocaboy (1996) for the 1994 reforms in France.

local decision making produces inefficient outcomes, e.g., in the case of externalities. If that is not the case, unconditional block grants are the most efficient grants, as they do not distort local governments' spending decisions.

More recent studies of intergovernmental grants stress that this conclusion only holds under conditions of full information and unlimited capacity on the part of the central government to commit itself to grant policy. If local governments expect that the central government will bail them out ex post with extra grants, a moral hazard problem occurs, and local governments are likely to overspend (e.g., Goodspeed 2002). This soft budget constraint literature is closely related to the literature on decentralized leadership (e.g., Köthenbürger 2004; Akai and Sato 2008; Breuillé et al. 2010). In these studies, local jurisdictions make their taxing and spending decisions ex ante, and the central government decides on grant allocation ex post.

In our model, however, there is no soft budget constraint, and the grant allocation system is determined ex ante. But we do have asymmetric information. If eligibility rules and benefit levels are determined centrally, local governments need sufficient revenues to pay out benefits. Exogenous determinants of welfare dependency (e.g., health, education, labor market) differ considerable between jurisdictions. The welfare block grant allocation should account for this. This touches upon the literature on *fiscal equalization*. In many countries, fiscal disparities are equalized to some extent through a system of intergovernmental grants.[4] Equalization of spending needs requires quantifying them, which is notoriously difficult (Duncan and Smith 1996). One of the techniques that may be employed is a regression of spending on cost determinants (Ladd 1994; Bradbury and Zhao 2009). This technique is used in the Netherlands to derive the welfare grant allocation formula.

However, asymmetric information limits the central government's ability to design an *optimal grant* ex ante (e.g., Raff and Wilson 1997; Cornes and Silva 2002; Huber and Runkel 2006; Breuillé and Gary-Bobo 2007). Like these studies, we analyze a model where the central government cannot directly observe whether a local government has high or low costs. However, in our case, cost disparities among local governments can be estimated. This estimate is biased because local government efficiency levels are unobserved and thus omitted from the regression. As the grant allocation system provides an incentive to reduce inefficiency, this bias may decrease over time.

3 Welfare Finance in the Netherlands

The territory of the Netherlands is divided into 408 (in 2013) local governments, or municipalities. Municipalities are responsible, among other things, for administering welfare. Eligibility rules and welfare benefit levels are uniform across the country. Until 2001, each municipality financed 10 % of its welfare benefits from its own coffers, while 90 % was reimbursed by the central government through an open-ended

[4] Equalization has been advocated on the grounds that it improves locational efficiency (Buchanan 1950, 1952; Buchanan and Goetz 1972; Boadway and Flatters 1982); on equity grounds (Le Grand 1975; Bramley 1990); as an insurance against regional shocks (Bucovetsky 1998; Von Hagen 2006) and in order to improve transparency and thereby facilitate the local decision making process (Allers 2012). For a review of the arguments for equalization, see Boadway (2006).

matching grant. Clearly, this did not provide a strong incentive to limit welfare payments by helping recipients find work or by clamping down on fraud. In order to improve this incentive, the match rate was reduced from 90 to 75 % in 2001. As from 2004, matching grants have been replaced by block grants. If a municipality spends more than its block grant, it bears the extra expenditures itself (up to a point, see below). If it spends less, it may use the balance as it sees fit.

In addition to benefit payments, municipalities also incur administrative costs. We define administrative costs as the costs of running a welfare program over and above the welfare benefit payments themselves. Administrative costs include, inter alia, the costs of establishing eligibility, of helping welfare recipients find a job (e.g., work programs), and of fraud investigations. Administrative costs are paid partially out of an earmarked block grant, and partially out of own resources.[5] Own resources include a (considerable) equalizing unconditional lump-sum grant from the central government and (comparatively modest) local tax revenues.

The nationwide budget available for welfare block grants, referred to as the *macro budget*, is calculated annually based on forecasts of the number of persons eligible for welfare. These forecasts are made by the independent Netherlands Bureau for Economic Policy Analysis (CPB). Forecasts are based on the number of welfare beneficiaries, the development of the number of unemployed in the previous years,[6] and regulatory changes that may affect welfare volumes.

The macro budget is allocated over municipalities according to the following rules. For small municipalities (fewer than 25,000 inhabitants, where 8 % of welfare recipients live), the share of the macro budget in year t depends on their share of welfare expenditures in year $t-2$. For large municipalities (40,000 inhabitants and more, 81 % of welfare recipients), a formula applies, which includes both demographic and labor market characteristics. The allocation formula is updated regularly. Because a formula that covers smaller municipalities reasonably well could not be derived, this method does not apply to them. For medium-sized municipalities, a hybrid system applies: their share is partly derived from their expenditure share in year $t-2$, and partly from the formula.

It has proved difficult to derive a stable allocation formula. Municipalities may see their calculated share of the macro budget rise or fall considerably from one year to the next. In order to insulate local governments from budgetary shock too great to cope with, differences between the block grant and actual welfare expenditures are limited both *ex post* and *ex ante*.[7]

[5] Every municipality receives a block grant ("participatiebudget") earmarked for helping unemployed persons find work, for integrating immigrants and for educating adults with insufficient schooling. Unlike the grant aimed at financing local welfare benefits, this grant cannot be used for other purposes. Therefore, we assume it does not enter the local government's utility function, and we ignore this grant in the following sections. Faber and Koning (2012) provide a detailed analysis of this grant and how it influences the behavior of municipalities.

[6] People losing their job normally are entitled to unemployment benefits for a period which depends on their employment history. After this period, they may apply for a (usually lower) welfare benefit if they have insufficient means to support themselves and their families.

[7] In Toolsema and Allers (2012, Appendix B) we extend the model to include these limits.

The welfare grant allocation formula contains 14 variables.[8] Among these are the number of single parent households, the number of lowly educated people, employment growth in the region to which the municipality belongs, and the number of disability benefits. The weights of these variables are derived annually[9] from a regression at the municipal level of welfare expenditures on the determinants included in the formula.

If municipalities operate at different levels of efficiency, actual welfare expenditures are a biased indicator of spending need, which is defined as the welfare spending a municipality would incur if it operated efficiently (as defined above). Greater efficiency in the past results in lower welfare expenditures, which translates into lower weights in the formula for the variables on which the municipality scores relatively high, and therefore into a lower grant. As a result, bad behavior in the past is rewarded. This provides perverse incentives and distorts efficiency. However, the allocation formula is updated regularly, and policymakers expect that, as the new grant design improves efficiency across the board, this bias will gradually disappear. We will show that this is not to be expected.

4 Local Governments' Efficiency Decision

In this section we focus on the choice of the efficiency level by the local authorities, using a very general function to describe the grant allocation method. We will turn to specific allocation methods in the next section.

4.1 Model

We assume that the efficiency decision is not only based on a local government's expenditures on welfare and on grant allocation, but also on some 'easy life function', which describes the monetary equivalent of the utility that the local government's administrators derive from working inefficiently. This utility may, e.g., take the form of political gains that may be derived from handing out benefits generously, or it may simply reflect the utility of leaning back and not exerting too much effort on work programs or enforcement.[10] Furthermore, we assume that the local government takes into account how actual welfare expenditures will depend on the level of inefficiency. That is, although the central government does not observe the local governments' inefficiency levels, the local government has full information. We impose a maximum inefficiency level,[11] which should be interpreted as follows. Although the central gov-

[8] We describe the Dutch system as it existed in 2013.

[9] In practice, the grant formula is left unchanged in some years.

[10] It is common to use effort as a strategic variable in this type of models. In our setting, inefficiency can be reinterpreted as being negatively related to effort, and the model could be reinterpreted in terms of effort. We focus the discussion on the variable inefficiency rather than effort because inefficiency is the key variable of interest here, and this makes the results easier to interpret.

[11] The assumption of a maximum inefficiency level does not qualitatively affect the results. It merely avoids the possibility of extreme inefficiency which does not seem to make sense in practice.

ernment cannot observe the inefficiency level, it will notice when a local government 'misbehaves' in an extreme way, in which case it will intervene. Finally, we assume that the local government pays administrative costs out of its own resources.

As a benchmark we first consider the case of an open-ended matching grant. Suppose that the central government reimburses a share $1-\alpha$ of a local government's welfare payments, leaving only a share α to be paid out of the local government's own resources. This yields the following maximization problem for the local government under the matching grant, which is indicated by a subscript 0 denoting the benchmark situation:

$$\begin{aligned} P_0 : \max_{Z_0} & -\alpha Y_0 - C(Z_0|X) + L(Z_0) \\ \text{s.t. } & Y_0 = X\beta + Z_0\gamma \\ & Z_0 \leq Z^{\max}. \end{aligned} \tag{1}$$

Here, Z_0 denotes the inefficiency level of the local government, $Z_0 \geq 0$ and greater Z_0 means greater inefficiency. Y_0 denotes the local government's welfare expenditures[12] and is determined both by Z_0 and by the exogenous spending need determinants X (a $1\times n$ vector). We let X be time-independent for expositional convenience. In reality these variables may change over time, but they do so only gradually, and they cannot be influenced by the welfare administrators. $C(Z_0|X)$ is the administrative cost function evaluated in Z_0, with $C(Z|X) \geq 0$, $C'(Z|X) < 0$, and $C''(Z|X) \geq 0$. That is, more inefficiency lowers administrative costs, e.g., because of less effort to help beneficiaries find work, but it does so at a decreasing rate. $L(Z_0)$ is the easy life function with $L'(Z) > 0$, and $L''(Z) \leq 0$, so more inefficiency makes administrators' lives easier, but it does so at a decreasing rate. $Z^{\max}$ is the maximum inefficiency level. Finally, α, β (an $n\times 1$ vector), and γ are parameters, with $\gamma > 0$. Note that $1-\alpha$ is the match rate of the welfare grant to the local government, with $\alpha \in [0, 1]$. We focus on a single period in this maximization problem. Including future periods in the objective function (as we do below) would not affect the solution for the problem under the matching grant, P_0, however, and therefore we ignore those for expositional convenience.

It is important to note that the central government can observe welfare expenditures Y and spending need determinants X, but not the inefficiency level Z. Also, the parameter β is not observed by the central government. Although X is assumed to be constant, the parameter β may change over time as macro-economic conditions vary. The central government cannot infer Z from the observables.

Now consider a block grant system along the lines of the Dutch welfare reform. We use a time subscript $t \geq 1$ because future periods do matter under this system. The block grant for year t depends on last year's welfare expenditures of all local governments together and on macroeconomic variables, which together determine the macro budget, as well as on a grant allocation formula. Consequently, a local government can only influence the grant in year t via its inefficiency level in the

[12] In this paper, 'welfare expenditures' refers to welfare benefit payments only; they do not include administrative costs.

previous year, Z_{t-1}. Thus, under the block grant system at time $t \geq 1$, the local government solves the following problem:

$$P_t : \max_{Z_t} \sum_{\tau=t}^{\infty} \delta^{\tau-t} \left[B_\tau(Z_{\tau-1}) - Y_\tau - C(Z_\tau|X) + L(Z_\tau) \right] \quad \text{s.t. } Y_\tau = X\beta + Z_\tau\gamma \quad Z_\tau \leq Z^{\max} \; \forall \tau = t, t+1, \ldots \tag{2}$$

Here, we define $\delta \in [0, 1]$ to be the discount factor. B_τ represents the grant at time τ, where we impose $B'_\tau(Z_{\tau-1}) \geq 0$. This assumption implies that inefficiency is rewarded by a larger grant in the next period. We also assume that the greater the local government, the larger the effect of its behavior on its future grant. Note that formally, B_τ is a function of $Y_{\tau-1}$, which itself is a function of $Z_{\tau-1}$. We simplify this by writing B_τ as a function of $Z_{\tau-1}$. Also for simplicity, we assume that local governments differ only in their Z, X, and Y and B; not in their functions L and C or parameters α, β, γ, and δ.

With this very general allocation rule B_τ, we will now derive our main results. Next, in Sect. 5, we will study the effects of specific allocation methods in more detail.

4.2 Solution

In the benchmark case, under a matching grant, the local government solves the problem P_0 in (1). This yields the first-order condition (FOC)

$$L'(Z_0) - C'(Z_0|X) = \alpha\gamma. \tag{3}$$

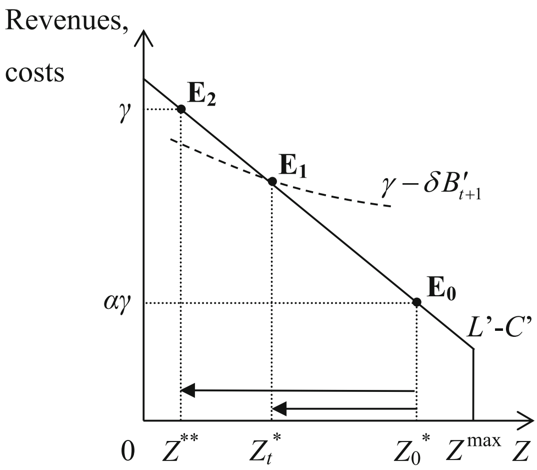
We assume in the following that the FOC (3) has an interior solution denoted by Z_0^*. Under the block grant the local government solves the problem P_t in (2). The corresponding FOC is

$$L'(Z_t) - C'(Z_t|X) = \gamma - \delta B'_{t+1}(Z_t). \tag{4}$$

Now the match rate is zero ($\alpha = 1$) and there is a block grant B_{t+1} which depends on Z_t. We assume an interior solution Z_t^*. Note that in both cases the equilibrium efficiency level depends on the exogenous variables in the allocation formula, so different local governments (with different X) will choose different efficiency levels even if the functions C and L are the same across local governments. Recall that we interpret efficient administration as one where only those who truly need it receive a welfare benefit. That is, our analysis ignores technical inefficiency and externalities.

The solution is shown graphically in Fig. 1. Figure 1 illustrates how the FOC balances marginal benefits of increased inefficiency (increased easy life and reduced administration costs, i.e., $L' - C'$) and the associated marginal costs (increased net-of-grant welfare expenditures, i.e., $\alpha\gamma$). Given our assumption, marginal benefits are positive and decreasing in Z. In the Figure, equilibrium occurs at the point where marginal benefits equal $\alpha\gamma$ under the benchmark matching grant, or $\gamma - \delta B'_{t+1}(Z_t)$

Fig. 1 Equilibrium choice of efficiency Z with block and matching grants



under the block grant. With a fixed block grant, or without any grant, the match rate is zero, so $\alpha\gamma = \gamma$, and the local government chooses efficiency level Z^{**} which is the lowest inefficiency level that can be reached by changing the grant system. This equilibrium arises if local governments have no influence whatsoever over the grant they receive. For expositional convenience, and because perfect efficiency seems unlikely even in this case, we assume that $Z^{**} > 0$.

4.3 Results

Now consider what happens if a matching grant is replaced by a block grant. Marginal benefits of inefficiency (increased easy life and reduced administrative costs) remain unchanged, but marginal costs change from $\alpha\gamma$ to $\gamma - \delta B'_{t+1}(Z_t)$. The new marginal cost term describes the effect of Z_t on the local government's welfare expenditures, γ, minus the present value of the budget increase in the next period. Together, this can again be interpreted as the effect on net-of-grant welfare expenditures.

Comparing the two expressions for marginal cost of inefficiency reveals the following. First, a matching grant ($\alpha < 1$) reduces the costs of an extra welfare beneficiary from γ to $\alpha\,\gamma$, leading to a higher level of inefficiency (see Fig. 1). Second, the block grant as described above makes future grants depend on current inefficiency (via expenditures) and thereby reduces the marginal costs of spending as well, this time to $\gamma - \delta B'_{t+1}(Z_t)$. Moral hazard arises because local governments have an incentive to reduce their efficiency in order to get a higher grant in the future. Thus, both the matching grant and the block grant with dependence on previous inefficiency affect the local governments' inefficiency decision in a similar way: by influencing the balance between marginal costs and benefits of inefficiency. Using Fig. 1 we obtain the following result.[13]

[13] In Fig. 1 we have drawn $\gamma - \delta B'_{t+1}(Z_t)$ as a decreasing function of Z_t, but it could alternatively be increasing (or even nonmonotonic) depending on the sign of $B''_{t+1}(Z_t)$.

Proposition 1 *Moving from a matching grant to a block grant may induce a local government to increase efficiency* ($Z_t^* < Z_0^*$)*, depending on parameter values.*

Note however that, depending on the shapes of L', C', and B'_{t+1}, and the values of the parameters α, γ, and δ, the equilibrium inefficiency level may in fact increase rather than decrease with the introduction of a block grant system. This can be seen as follows. The FOC (4) associated with the new system can be rewritten as

$$L'(Z_t) - C'(Z_t|X) - \gamma + \delta B'_{t+1}(Z_t) = 0.$$

We can evaluate the left-hand side of this FOC in the benchmark equilibrium inefficiency level Z_0^* (i.e., substituting the FOC (3) for time $t = 0$) as

$$\alpha\gamma - \left\{\gamma - \delta B'_{t+1}\left(Z_0^*\right)\right\}.$$

As can also be seen from Fig. 1, the inefficiency level Z will decrease relative to Z_0^* with the introduction of the new system if this expression is negative ($\gamma - \delta B'_{t+1}\left(Z_0^*\right) > \alpha\gamma$), but it will increase instead if the expression is positive. The expression is increasing in α and δ and decreasing in γ. Thus, for the block grant system to indeed enhance efficiency, we need both the match rate under the old system $(1 - \alpha)$ and the effect of a local government's inefficiency on its welfare expenditures (γ) to be sufficiently large, and the discount factor (δ) to be sufficiently small. Also, since $B'_{t+1} \geq 0$, the function B_{t+1} should not be too steep.

Now, we compare small with large jurisdictions. By construction, the smaller the jurisdiction, the smaller the effect of increased efficiency by that jurisdiction on the macro budget, and thereby on the jurisdiction's next period grant. Therefore inefficiency levels are more likely to decrease for relatively small local governments than for large local governments, and in general in settings with many local governments. Thus, if parameter values are such that the introduction of a block grant *decreases* efficiency only for some local governments, this will be the case for relatively large jurisdictions (see also Sect. 5.1).

Conjecture *The efficiency boost from replacing a matching grant by a block grant will decrease with local government size.*

From inspection of the FOCs and Fig. 1 it is also easy to derive the following result.

Proposition 2 *Under a fixed block grant complete efficiency* ($Z = 0$) *will not necessarily obtain, depending on parameter values.*

The most efficient grant is a fixed block grant, equivalent to a matching grant with $\alpha = 1$. With such a grant, equilibrium occurs at Z^{**}, which is still higher than zero except when $\gamma \geq L'(Z_t) - C'(Z_t|X)\ \forall\ Z_t$. So, in general, we have both less than perfect efficiency, and continuing disparities in efficiency across local governments.[14,15]

[14] Recall that, apart from size differences, differences in the exogenous variables X cause inefficiency levels to differ across local governments (via the administrative cost function C).

[15] In Toolsema and Allers (2012) we extend the model to include possible loss aversion. The municipality's objective function may put a greater weight on a deficit than on a surplus.

5 Comparing Different Block Grants

The grant function B_{t+1} is part of the design of the welfare allocation model, and therefore can be influenced by the policy maker. We now turn to a discussion of the implications of some specific allocation models using block grants, and compare them with a matching grant. For simplicity, we set the macro budget equal to total welfare expenditures in the previous period. In this section we index local governments by a subscript i, $i = 1, \ldots, m$.

5.1 Fixed Shares

We begin with a simple hypothetical system where every local government receives a fixed share of the macro budget. By decreasing Z_i, a local government receives the benefits of greater efficiency while sharing the cost in terms of a reduced grant in the next period (resulting from a lower macro budget) with all other local governments.

The grant for local government i in period $t \geq 1$ is given by

$$B_{i,t} = \theta_i \sum_{i=1}^{m} Y_{i,t-1}, \tag{5}$$

where θ_i is the fixed share of local government i in the macro budget. The θ_i's are exogenous parameters and are assumed to be independent of t in this subsection, with $\theta_i \in [0, 1]$, $\sum_{i=1}^{m} \theta_i = 1$. For example, they could be determined as historical shares by $\theta_i = Y_{i,0} / \sum_{i=1}^{m} Y_{i,0}$. Note that if a local government increases its expenditures by one euro, its grant for next year increases by $\theta_i \leq 1$ euros. We now have $B'_{i,t+1}(Z_{i,t}) = \theta_i \gamma$, and the FOC (4) becomes

$$L'(Z_{i,t}) - C'(Z_{i,t}|X_i) = \gamma(1 - \delta\theta_i).$$

Comparing this to the FOC with a matching grant (3) shows that local government i increases efficiency after the introduction of the block grant system if and only if $\delta\theta_i < 1 - \alpha$. Here, $\delta\theta_i$ is the present value of the grant increase in the following year resulting from spending one additional euro on welfare under the fixed shares block grant system, while $1 - \alpha$ represents the grant increase resulting from spending one additional euro on welfare under the matching grant system.

Proposition 3 *A block grant with fixed shares θ_i entails $B'_{i,t+1}(Z_{i,t}) = \theta_i \gamma$. This block grant is more efficient than a matching grant if and only if $\delta\theta_i < 1 - \alpha$. This is more likely for local governments with a low share θ_i of the macro budget.*

This clearly illustrates the result presented in Conjecture 2 that, ceteris paribus, large local governments (those with greater θ_i, for example due to their large share in historical welfare expenditures) will have greater inefficiency under the block grant system. Large local governments therefore are more likely than small local governments to decide to increase rather than decrease their inefficiency level after the introduction of the block grant.

5.2 Grant Based on Previous Period Share

Inspired by the Dutch system for small municipalities, we now let the grant share depend on a local government's share in welfare expenditures in the previous period. Thus, $\theta_{i,t} = Y_{i,t-1}/\sum_{i=1}^{m} Y_{i,t-1}$. In this case, $B_{i,t}$ depends on $Z_{i,t-1}$ not only because $Z_{i,t-1}$ influences the macro budget, but also because it now influences the local government's share of the macro budget.

Substituting the expression for $\theta_{i,t}$ into the expression for the grant of local government i, (5), immediately yields $B_{i,t} = Y_{i,t-1}$. Given our assumption about the determination of the macro budget (i.e., the macro budget equals total welfare expenditures in the previous period), a local government's grant for year t simply equals its expenditures in the year before. Thus, each euro of expenditures directly translates into one euro grant for next year. This implies $B'_{i,t+1}(Z_{i,t}) = \gamma$. Note that with fixed shares (the previous subsection) this derivative is multiplied by the share θ_i, which will in general be small. Thus, this derivative is much larger with grants based on the previous period's share than it is with fixed (historical) shares. The right-hand side of the FOC (4) now equals $(1-\delta)\gamma$ and is much smaller than with fixed shares, implying that we now have far greater $Z_{i,t}$ in equilibrium.

Proposition 4 *With previous period shares we have $B'_{i,t+1}(Z_{i,t}) = \gamma$ and the block grant system is more efficient than a matching grant if and only if $\delta < 1 - \alpha$. This is much less likely than with fixed shares.*

This result is easily understood. In the condition $\delta < 1 - \alpha$, the δ represents the present value of the grant increase in the following year resulting from spending one additional euro on welfare under the fixed shares block grant system, while $1 - \alpha$ represents the grant increase resulting from spending one additional euro on welfare under the matching grant system.

5.3 Grant Based on Regression

If block grants are used but equity is a concern, past expenditures are probably not the best instrument to improve equity. With exogenous spending need determinants observable to all parties, econometric techniques allow forecasting future spending needs and allocating the available budget accordingly. This method is used in the Netherlands for large municipalities. There is, however, one problem with this method. As reflected in the model from the previous subsection, there is an additional explanatory variable, inefficiency, which cannot be observed. In practice, this variable is ignored when estimating spending need.[16] Below we analyze how this omitted vari-

[16] Some studies of expenditure needs try to control for differences in efficiency by including efficiency-related variables in the regression, e.g., the local tax price or political variables (Duncombe and Yinger 1997; Bradbury and Zhao 2009). Perhaps such variables can be successfully applied to reduce the omitted variable problem to some extent, but it seems highly unlikely that it can be eliminated this way.

able problem affects grant shares and efficiency. In doing so, we ignore the effect of Z on the size of the macro budget.[17]

First consider the 'true model' relating Y to X,

$$Y_t = X\beta + Z_t\gamma + \mu_t, \tag{6}$$

using matrix notation. Here, Y_t, Z_t and μ_t are $m \times 1$ vectors, with m the number of local jurisdictions, X is an $m \times n$ matrix with n the number of exogenous spending need determinants, and β ($n \times 1$) and γ (scalar) are parameters. This is the same equation relating Y to X and Z as before, see (1), but now with an i.i.d. disturbance term added (we assume that $E\mu_t = 0$). For a truly fair grant allocation, one would need to know the parameter β. However, since Z_t is unobservable, β cannot be estimated. The regression model used is therefore an approximation:

$$Y_t = X\varphi + \varepsilon_t, \tag{7}$$

assuming that the disturbance term is i.i.d. with $E\varepsilon_t = 0$.[18] Clearly, the estimate $\hat{\varphi}$ which results from this estimation is a biased estimate of β, unless X and Z_t are orthogonal, which is highly unlikely.

The model (7) is re-estimated every year, so the estimate of φ changes annually. The estimate for φ calculated at time $t$is given by $\hat{\varphi}_t = (X'X)^{-1}X'Y_t$, with $\hat{\varphi}_t$ an $n \times 1$ vector. The grant for next year is given by $B_{t+1} = X\hat{\varphi}_t$, where B_{t+1} is an $m \times 1$ vector. Thus, the grant equals predicted welfare expenses $\hat{Y}_t$ according to the regression model (7). Note that the it depends not only on X_i, but on both spending need determinants X and inefficiency levels Z at time t of *all* local governments.

The relevant FOC is similar to the FOC (4) in Sect. 4.2. With some abuse of notation, we now have

$$L^d(Z_t) - C^d(Z_t|X) = \gamma\iota - \delta B^d_{t+1}(Z_t). \tag{8}$$

Here, L^d, C^d and B^d are $m \times 1$ vectors and ι is an $m \times 1$ vector of ones. The superscript d denotes the derivative with respect to the variable between brackets. E.g., the i-th element of L^d is the derivative of L with respect to Z, evaluated in $Z_{i,t}$.

For the derivative of the grant $B_{i,t+1}$ with respect to $Z_{i,t}$ note that in the expression for $B_{i,t+1}$, $Z_{i,t}$ enters only via $\hat{\varphi}_t$, and in the expression for $\hat{\varphi}_t$ itself $Z_{i,t}$ enters only via $Y_{i,t}$. The derivative of the vector Y_t with respect to $Z_{i,t}$ is a vector which has zeros everywhere except for the i-th element, which equals γ. Thus, the derivative of $\hat{\varphi}_t$ with respect to $Z_{i,t}$ equals γ times the i-th column of the matrix $(X'X)^{-1}X'$, and the derivative of $B_{i,t+1}$ with respect to $Z_{i,t}$ equals the i-th row of X multiplied by this γ times the i-th column of the matrix $(X'X)^{-1}X'$. Thus, we have the following.

[17] We ignore the fact that predicted expenses may not sum to exactly the same amount as actual expenses. Including this would imply scaling, i.e. multiplying each element of the vector B_{t+1} by the same number, which is determined exogenous of the model.

[18] We assume that the regression model includes the correct set of exogenous variables X_j, $j = 1, \ldots, n$.

Proposition 5 *With the regression method we have* $B^d_{i,t+1}(Z_{i,t}) = \gamma \left[X(X'X)^{-1}X'\right]_{ii} \equiv \gamma h_{ii}$ *and the block grant system increases efficiency if and only if* $\delta h_{ii} < 1 - \alpha$.

Note that the effect of increased efficiency of local government i on its next period's grant depends on exogenous spending need determinants X of all local governments, but it does not depend on (any) inefficiency levels. Furthermore, local government i's grant $B_{i,t+1}$ reacts strongly to its inefficiency level $Z_{i,t}$ if (and only if) h_{ii}, the i-th diagonal element of the matrix $X(X'X)^{-1}X'$, is large (in absolute value). This matrix is known as the projection matrix or hat matrix. It transforms observed values Y_t into predicted values $\hat{Y}_t : \hat{Y}_t = X\hat{\varphi}_t = X(X'X)^{-1}X'Y_t$. The diagonal elements of the hat matrix, h_{ii}, can be interpreted as leverages. They describe the influence of an observation on the predicted value for that observation. A high value of h_{ii} means that the observation $Y_{i,t}$ is influential in determining $\hat{Y}_{i,t}$. It is well known (e.g., Hoaglin and Welsch 1978) that $0 \leq h_{ii} \leq 1$, and that the average value equals n/m, where n is the number of parameters (here: exogenous spending need determinants) and m the number of observations (here: local jurisdictions). Clearly, if $\hat{Y}_{i,t}$ is determined to a relatively large extent by $Y_{i,t}$, then the grant $B_{i,t+1}$ is determined to a relatively large extent by $Z_{i,t}$. Finally, the inequality in the proposition compares the present value of the eventual block grant increase resulting from spending an additional euro on welfare, δh_{ii}, with the grant increase due to spending one more euro when a matching grant is in place $(1-\alpha)$. Local government i is particularly likely to increase efficiency after the introduction of the block grant if α and δ are small, and the observation $Y_{i,t}$ is not too influential (h_{ii} is small, which is generally the case if $m \gg n$). Compared to a fixed block grant, where marginal costs from welfare spending equal γ, the regression-based allocation system yields lower marginal costs because of adjustments deemed necessary out of equity concerns.

We now turn to the effects of the omitted variable problem. To be truly equitable it is desirable that the regression model (7) will converge to the true model (6) as local governments start working more efficiently as a result of the incentives inherent in the block grant system. Thus, the estimated parameter $\hat{\varphi}_t$ should converge to the true parameter β, and the grant B should converge to the 'fair' grant $X\beta$, at least in expected value. The expected value of the grant according to our model equals

$$\begin{aligned} EB_{t+1} &= EX\hat{\varphi}_t \\ &= E\left[X(X'X)^{-1}X'Y_t\right] \\ &= E\left[X(X'X)^{-1}X'(X\beta + Z_t\gamma + \mu_t)\right] \\ &= X\beta + X(X'X)^{-1}X'Z_t\gamma. \end{aligned}$$

Thus, the expected value of the grant at time $t+1$ equals the fair grant $X\beta$ plus an additional term, $X(X'X)^{-1}X'Z_t\gamma$, which depends on both spending need determinants and efficiency levels in all jurisdictions. It is well known that the omitted variable problem affects the expected value of the estimated parameter ($\hat{\varphi}_t$), but not its variance. The omitted variable bias is given by[19] $E\hat{\varphi}_t - \beta = (X'X)^{-1}X'Z_t\gamma$.

[19] Note that this bias equals γ times the slope from regressing Z_t on X.

Table 1 Marginal cost of welfare spending under different grants (RHS of FOC)

Grant type	Marginal cost of welfare spending
Fixed block grant (or no grant)	γ
Matching grant	$\alpha\gamma$
Fixed shares block grant	$(1-\delta\theta_i)\,\gamma$
Previous period shares block grant	$(1-\delta)\,\gamma$
Regression-based block grant	$(1-\delta h_{ii})\,\gamma$

Even if one of the regressors in X is uncorrelated with Z_t, its estimate will be biased unless the regressor is uncorrelated with all other regressors too. In the current setting it seems reasonable to assume that the regressors are all correlated, so the estimate $\hat{\varphi}_t$ is biased for all local governments.. The bias is nonzero except in the special case where $Z_t = 0$, or when X and Z are orthogonal. Thus, convergence of the grant B to the fair grant $X\beta$ is highly unlikely. It is difficult to sign the omitted variable bias. Since all regressors in X can be pairwise correlated, it is next to impossible to obtain the direction of the biases.

Proposition 6 *Due to the omitted variable problem, under the regression method the estimated model does not converge to the true model, and the expected grant does not converge to the fair grant.*

5.4 Grant Comparison

The first order condition describing the local government's efficiency choice sets the marginal benefit of welfare spending equal to the marginal cost, i.e., net-of-grant welfare expenditures. Table 1 summarizes marginal costs for different grants, as derived above. They are constant for all grant types we study but for some grant types they differ across municipalities. In Fig. 1, the various marginal cost levels could be represented by horizontal lines. The equilibrium inefficiency level decreases with increasing marginal cost of welfare spending, because higher marginal costs increase the incentive to work efficiently. Whether a block grant gives municipalities a bigger incentive to work efficiently than a matching grant depends on parameter values. However, given that $\theta_i \in [0, 1]$ and $h_{ii} \in [0, 1]$, Table 1 shows that a previous period shares block grant gives a smaller efficiency incentive than block grant where shares are fixed or regression-based, except in extreme cases.

Table 2 summarizes the effects of replacing a matching grant with a block grant and includes two numerical examples to be discussed further in the next subsection. For example, it shows that the fixed shares block grant is more efficient than the matching grant if $\delta < \frac{1-\alpha}{\theta_i}$. Note that the denominator reflects the increase in next year's grant resulting from spending more under a fixed shares block grant. With a previous period shares block grant, spending one additional euro results in one euro in extra grant money next year and the denominator becomes one, and with regression-based shares the denominator becomes h_{ii}. In general, replacing a matching grant with a block grant improves efficiency if α and δ are sufficiently small. For a fixed

Table 2 Efficiency effects of replacing a matching grant with a block grant

Block grant type	Efficiency improves if and only if	$\alpha = 0.10$	$\alpha = 0.25$
Fixed shares	$\delta < \frac{1-\alpha}{\theta_i}$	$\delta < 367$ (for average θ_i)	$\delta < 306$ (for average θ_i)
	(Proposition 3)	$\delta < 8.2$ (for the highest θ_i)	$\delta < 6.8$ (for the highest θ_i)
Previous period shares	$\delta < 1 - \alpha$ (Proposition 4)	$\delta < 0.9$	$\delta < 0.75$
Regression-based	$\delta < \frac{1-\alpha}{h_{ii}}$ (Proposition 5)	$\delta < \frac{0.9}{h_{ii}}$ (average h_{ii}: $\delta < 14$)	$\delta < \frac{0.75}{h_{ii}}$ (average h_{ii}: $\delta < 12$)

shares block grant, efficiency additionally requires small θ_i, and for a regression-based grant, efficiency additionally requires small h_{ii}. The latter implies m $\gg$ n, or many jurisdictions and relatively few exogenous welfare spending need determinants. Note that policymakers can increase block grant efficiency by increasing the time lag between local governments' spending behavior and the resulting effect on grant size (decreasing the discount factor).

5.5 Application to the Netherlands

We now apply our results to the Dutch case. In the Netherlands, local governments originally received an open-ended matching grant to finance welfare spending, as described by the benchmark model above, with $\alpha = 0.25$.[20] In 2004, this was replaced by a system of block grants.

First, we compare the matching grant with a block grant where the shares θ_i in the macro budget for different local jurisdictions are fixed. In the Netherlands, the average value[21] of θ_i equals 0.002 and the maximum value equals 0.11 (Amsterdam). According to Table 2, introducing a block grant with fixed shares increases efficiency even in the largest municipality if $\delta < (1 - 0.25)/0.11 = 6.8$, which holds since $\delta \in [0, 1]$. With high values of α, however, it is conceivable that introducing a block grant actually decreases efficiency in some large municipalities. For the Netherlands, this would require $\alpha \geq 0.90$ (again using $\theta_i = 0.11$ for Amsterdam and assuming $\delta = 0.95$), which is much higher than it has ever been. Thus, we can conclude that replacing the matching grant that existed in the Netherlands with a (hypothetical) block grant with fixed shares would have increased efficiency in all municipalities.

Now consider previous period shares. Since 2004, the grant share of small municipalities in the Netherlands (<25,000 inhabitants, where 8 % of welfare recipients reside), depends on their share in welfare expenditures at $t-2$. Using δ^2 instead of δ, municipality i increases efficiency if a matching grant is replaced by a grant based on

[20] In 2001–2003. Until 2001, $\alpha = 0.10$. Results are given in Table 2.

[21] Calculated as 1/408, where 408 is the number of municipalities.

previous expenditure shares if and only if $\delta^2 < 1-\propto$, that is, this requires a discount factor, $\delta < \sqrt{1-0.25} = 0.87$, which seems implausibly low. Thus, the new grant may have *reduced* efficiency for small municipalities.

For large municipalities (≥40,000 inhabitants, where 81 % of welfare recipients live), regression-based grant allocation applies.[22] The average value[23] of h_{ii} is 0.06, and for this value the regression-based grant is more efficient than the matching grant if $\delta < \frac{1-0.25}{0.06} = 12$. As $\delta \in [0, 1]$ the average municipality has increased efficiency. However, some municipalities may have disproportionate influence on their estimated welfare expenditures. With a reasonably safe value of 0.95 for δ,[24] efficiency requires $h_{ii} < 0.79$, which may not hold for extreme outliers (recall $0 \leq h_{ii} \leq 1$).[25] For the extreme case where $h_{ii} = 1$, the regression-based grant is equal to the previous period shares block grant, and the efficiency condition is the same as well (see Table 2).

We can conclude that, according to our model, replacing the matching grant with a regression-based block grant in the Netherlands has increased efficiency in all municipalities concerned. This is in line with empirical evidence. Estimates of the effect of the introduction of block grants on the number of welfare recipients point to a reduction between 8 (Van Es and Van Vuuren 2010) and 15 % (Kok et al. 2007). However, the introduction of the previous period block grant for small municipalities may well have reduced efficiency there. The reason is that small municipalities face quite different incentives than large municipalities, due to the different grant systems used.

6 Conclusion

This paper discusses the use of regression-based block grants for a welfare system with decentralized administration but centralized financing. With uniform benefits and eligibility rules, welfare grants from the central government to local jurisdictions should be designed in such a way that they provide local governments with the right incentives to work efficiently, that is, give benefits only to those who really need it. Dutch policymakers use econometric techniques to forecast future spending needs from a regression of welfare expenditures on observable exogenous spending need determinants. With grant shares derived from such a regression, a block grant should ensure that local governments that operate reasonably efficiently will not need to use own resources to finance welfare expenditures. Because total grants add up to no more than forecasted aggregated welfare expenditures, excess spending is discouraged. In

22 The grant of medium sized municipalities is determined partly by their share in the previous period, and partly by regression results. The importance of both components depends on the number of inhabitants: with increasing size, regression results increase in importance.

23 In 2013. Calculated as n, the number of exogenous spending need determinants (14), divided by m, the number of large and medium sized municipalities (216).

24 Note that as it takes time for data to become available and for regression analyses to be carried out, the time lag in the Netherlands is usually bigger than 1 year (2–3 years). As a result, we are actually assuming here that δ^2 or δ^3 is 0.95, which is rather on the safe side.

25 As a rule of thumb in regression analysis, values exceeding two or three times the average value of h_{ii} (here: 0.13 or 0.19) are considered influential outliers that merit close inspection, and, possibly, exclusion from the analysis (e.g., Hoaglin and Welsch 1978).

this way, the Dutch aim to enjoy the benefits of block grants (efficiency), without the disadvantage associated with them (inequity). We focus on the effects of this method on efficiency, and show that it has two weaknesses.

First, unlike standard block grants the regression-based block grants reduce the marginal cost of welfare spending, because higher expenditures increase future grants. This provides perverse incentives to local administrators by lowering the marginal net-of-grant costs of welfare spending. We show that full efficiency is not likely to obtain with a regression-based block grant. In extreme cases, efficiency may be even lower than under a matching grant system for relatively large local governments, for which expenditures usually have a greater effect on future grants than for small ones. So, in general, this type of block grant will result both in less than perfect efficiency, and in continuing disparities in efficiency across local governments of different size.

Second, since inefficiency is not observed, the regression has an omitted variable problem and thereby a bias. We derive the size of this bias in our model. In contrast to what policymakers claim, we show that in our simplified setting the regression model does not converge to the true model and the grant does not converge to the fair grant due to the omitted variable bias. However, in cases with many local governments and a limited number of spending determinants, as in the Dutch case, this bias is small.

We can conclude that, according to our model, replacing the matching grant with a regression-based block grant in the Netherlands has increased efficiency in all municipalities concerned. The Dutch style regression-based block grant may be successfully applied by countries wishing to combine local administration, central financing, and efficient administration of welfare, while ensuring uniform eligibility and benefit levels and an equitable welfare burden for local jurisdictions. The method may also be applied to other programs. Our analysis shows under which conditions such regression-based grants may improve efficiency.

A limitation of our study is that we assume rational behavior and perfect information of local government administrators.[26] In practice, behavior might be driven by, e.g., the need to avoid short term deficits, and not everyone involved will fully understand the implications of every policy option. Thus, the effects of the grant types analyzed here might differ from our predictions. Still, it is important to analyze the effects grants have on well informed rational actors, if only to prevent some of them abusing the system.

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[26] Allers et al. (2013) analyze the way financial incentives influence local government behavior in practice, and describe the theories based on behavioral economics that are relevant in this context.

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