

# **Local adjustment to temporary matching grant programs: A dynamic analysis\***

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## **Abstract**

Matching grants are used to expand local government services of particular importance for the central government, centrally preferred services. In this paper we investigate the dynamic effects of temporary matching grant programs. The dynamic understanding includes expectations about future grant programs, consequences for post-program resource allocation, and separation between announced and unannounced grants. Compared to existing models of dynamic grant programs we introduce resource allocation issues with two services, one locally preferred service competing with the desires of the central government. In the two good, three period model (before, during and after a matching grant program) we show that both the locally and the centrally preferred services are reduced before an announced matching grant for current expenditures. The grant leads to shift of resource use over time and between services. Unannounced grants have important distribution effects since local governments that have given own priority to the centrally preferred service are 'punished'. They are less able to take benefit of grants and are more likely to have to crowd out the locally preferred service.

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## 1. Introduction

Local governments in Europe are part of the larger public sector and with financing and controls from the central government. In this setting central governments cannot avoid the blame for underperforming services at the local level. Responsibilities for schools, health care and care for the elderly are decentralized to local governments, but they are also an important part of national politics and election campaigns. It follows that central governments attempt at influencing local government service levels. Serious concerns of the incentives involved are raised in the second generation literature of fiscal federalism, see overviews by Oates (2005) and Weingast (2006). Here we address the incentives built into a particular type of central government intervention, temporary matching grant programs.

The main policy instrument used by central governments to influence the locals is matching grant. The static effects of matching grants are well understood in a comprehensive literature (see overview of Boadway and Shah, 2007). The empirical evaluation of the response to matching grants has been harder to identify, as discussed by Baker et al. (1999). Matching grants are motivated by externalities between local governments and the grants work as a subsidy to expand services with positive spillovers. The literature analyzing the effects of matching grants is static since externalities are assumed to be an essential and permanent aspect of the services.

Our interest here is focused on temporary matching grant programs. The issues have been of relevance in Norway where the central government has introduced several policy initiatives to raise local service quality and quantity. Recent examples of such ‘action plans’ are kindergartens for all and single rooms for all in care for elderly institutions. The essence of the government policy initiative is a matching grant program to stimulate spending for a particular service during a limited period. The grant programs have been controversial in the public debate, mainly because of the intervention into local self rule. They have also motivated strategic behavior of local governments based on expectations about grant programs and have affected the long run fiscal balance of deficits, investments and loans. We construct a model to handle the dynamics and discuss alternative matching grant designs.

The starting point of the model is the intertemporal determination of consumption assuming a

representative voter. The basic framework of fiscal dynamics is laid out by Zou (1994). He separates between short run and long run effects and between matching and nonmatching grants in a model determining aggregate local government spending. In his framework, temporary future matching grants for current expenditures leads to reduced investment. A temporary future increase in matching grants for investment has an ambiguous impact on investment. The local government is richer in the future, but also the opportunity cost of investment now is higher compared to the period of the matching grant. We simplify and expand his model, in particular to account for resource allocation issues with two local government services. Central governments typically promote one favorite service at the expense of other services given priority locally. We will name them the locally preferred service and the centrally preferred service.

The model separates between three periods – before, during and after a matching grant program. Given a benchmark of block grant financing, three types of matching grants are analyzed – matching current expenditure, announced investment grant and unannounced investment grant. Matching current expenditure is the conventional way of handling matching grants and with the standard price and income effects. Investments to expand capacity are neglected in the standard grant analysis, but matching grants to stimulate investments are important in practice. Including the investment decision also highlights the possibilities local governments have of shifting resource use over time and the importance of expectations.

The reference point is block grant financing of local governments. We show that an announced increase in block grants in the next period will raise all service production immediately. In our setting both the locally and the centrally preferred services will expand. From the point of view of the central government there is a ‘leakage’ of money to the locally preferred service. This is presumably the main motivation for matching grants. The analysis finds that the expectation of future matching grants for current expenditures motivates the local governments to reduce their own spending in the centrally preferred service to await future matching funds from the central government. The locally preferred service production is reduced before, during and after the program, and the desired shift to the centrally preferred service is achieved during and after the program. Furthermore, local governments that have given own priority to the centrally preferred service are ‘punished’ when unannounced matching grants are introduced since they are less able to take benefit of grants. The locally

preferred service production will go down following unannounced matching grants.

Section 2 introduces the dynamic model of local government behavior. Section 3 investigates alternative designs of temporary matching grant programs. The dynamics are explored using simulations in section 4. Section 5 looks at myopic behavior. Concluding remarks are offered in section 6.

## **2. A dynamic model of local government resource allocation**

The analysis concentrates on local government responses to temporary grant programs designed and implemented by the central government. We take the central government program design as exogenously given. The analysis deals with the consequences of central government interventions into the local government economy. Some recent literature has addressed the dynamic modelling of the decision making at the central government level in federal systems. Fiscal imbalances may result from incentives for bailout and intertemporal behavior related to mobility (Inman, 2003). Besfamilie and Lockwood (2008) and Boadway and Tremblay (2005) offer related multiperiod models discussing soft budget constraints and vertical fiscal imbalance. Other contributions of relevance have discussed the commitment problems of the central government in the design of grants, notably Caplan et al. (2000) and Koethenbueger (2007, 2008). In future research we will expand the analysis with explicit handling of the central government level.

Dynamic fiscal issues at the local level have mainly been analyzed in the context of shocks and imbalances (deficits) and involving fiscal discipline. The framework we suggest here is related to models used to study the effects of shocks. Gramlich (1978, 1991) analyzes fiscal crisis and fiscal balance in a simple two-period setup. In a related study of Danish local governments, Rattsø and Tovmo (2002) develop a simple two-period model of shock adjustment, also serving as the basis of the study of Norway by Rattsø (2004). Poterba (1995) introduces investment in a two period model analyzing borrowing rules and state capital spending. The model below can be seen as an expansion of Poterba to study expectations and matching grant programs. It can also be seen as a simplification of a more general model of future oriented planning as suggested by Holtz-Eakin and Rosen (1993) and applied in an investment analysis by Rattsø (1999).

The model describes a local government producing two services  $A$  and  $B$  and covers three periods. We name service  $A$  the locally preferred service and assume that it is produced by current expenditures only. The central government wants to stimulate the production of service  $B$ , the centrally preferred service. We broaden the description of service  $B$  by assuming that capacity investments are necessary for the production. Production of one unit of  $B$  requires one unit of capital ( $K$ ) and a fixed amount of current expenditures ( $b$ ).

The analysis is based on a three periods; the period before the grant program is implemented (period 1), the period when the grant program is effective (period 2), and the period after the grant program (period 3).

Capacity investments are made at the beginning of each period and contribute to production service  $B$  in the same period. The real capital stock depreciates at rate  $\delta$ . In the first two periods we assume that gross investment must be non-negative, i.e. the local government can not sell real capital in a market. However, given that we have a model with a fixed horizon, it is convenient to assume that the capital stock can be realized at the end of period 3.

We assume a centralized system of financing (like the Norwegian) where local governments are financed by grants and regulated taxes. In the benchmark case we neglect matching grants and assume that all revenues are in the form of block grants and regulated taxes. In the following these revenues are denoted block grants ( $R$ ). To simplify the real interest rate is set to zero. The intertemporal budget constraint implies that exogenous revenue in the three periods finances current spending for  $A$  and investment and current spending for  $B$ , taking into account that revenues are generated by selling the capital stock at the end of period 3 (see appendix). We use notation  $bK_t$  for current expenditures for service  $B$  and the revenues from selling the capital stock at the end of period 3 is  $(1-\delta)K_3$ . The present value of block grants is equal to the present value of the costs of service provision. Production of service  $B$  requires both capital and current expenditures, and the cost per unit of  $B$  is  $\delta + b$  in all periods.

The preferences of the representative voter is given by

$$U = u(A_1, K_1) + u(A_2, K_2) + u(A_3, K_3) \quad (1)$$

where the period utility function is assumed to be concave. The decision making process is described as maximization of the representative voter's utility subject to the local government budget restriction. The first order condition reads:

$$u_{A1} = u_{A2} = u_{A3} = \frac{u_{B1}}{\delta + b} = \frac{u_{B2}}{\delta + b} = \frac{u_{B3}}{\delta + b} \quad (2)$$

The optimality condition implies that the utility increase of the last dollar should be equalized across services and across periods. Moreover, since utility evaluation and costs are stable over time, this implies that service provision is stable over time. We can write  $A_t = A$ ,  $B_t = B$  and  $K_t = K$ . Investment and capacity build up can be described as follows: At the beginning of period 1 the local government invests  $K$ . At the beginning of period 2 and 3 there are investment to replace depreciation, and at the end of period 3 a capital stock of  $(1 - \delta)K$  is sold. It follows that the requirement of non-negative gross investment is fulfilled.

It is also of interest to analyze how grant programs affect the budgetary balance. We define the budget surplus (*SURPL*) as the difference between revenues and costs, where costs include current expenditures and depreciation:

$$SURPL_t = R_t - A_t - (b + \delta)K_t \quad (3)$$

The point of departure for the analyses of action plans is a situation with stable block grant financing, i.e.  $R_t = R$ . In this case there is stable service provision and budgetary balance in each period.

Increased block grant is the ordinary instrument to expand local government services in this economy. As a benchmark we first consider increased block grant in period 2. A block grant increase has a pure income effect, and in the case where the grant increase is known at the beginning of period 1, the local government will respond by increasing service provision in both service sectors in all three periods. Since the first order condition (2) applies, there will be stable service provision over time. However, there will not be budgetary balance in each period because the local use of the grant increase is distributed evenly across the three periods. The local government will run a deficit in period 1, a surplus in period 2, and a deficit in

period 3.

Central government wants to promote the centrally preferred service  $B$ . Although a block grant contributes to increased provision of service  $B$ , it is an inefficient policy from the point of view of the central government since the grant “leaks” to service  $A$ . This inefficiency may motivate a matching grant program. There is also “leakage” across periods, although this is presumably less problematic. It is probably to the advantage of the central government that the announced increased block grant in period 2 immediately increases service provision and that service provision remains high after the grant program is finished.

### 3. Matching grant programs

We assume that the central government is looking for more direct ways of stimulating their preferred service  $B$ . The following grant programs are considered:

- Grant program 1: Announced matching grant for current expenditures in period 2
- Grant program 2: Announced matching grant for investments in period 2
- Grant program 3: Unannounced matching grant for investments in period 2

#### *Grant program 1: Matching grant for current expenditures in period 2*

A matching grant for current expenditures in period 2 means that the central government finances a fraction  $m$  of current expenditures for service  $B$ . The intertemporal budget restriction is modified since the matching grant for current expenditures makes service  $B$  less expensive in period 2. In the analysis we assume that gross investments are non-negative in period 3. This implies that the capacity in period 3 is determined by the chosen capacity in period 2, i.e.  $K_3 = (1 - \delta)K_2$ . The budget restriction then becomes:

$$R_1 + R_2 + R_3 = A_1 + A_2 + A_3 + (\delta + b)K_1 + [(2 - \delta)(\delta + b) - mb]K_2 \quad (4)$$

The term within the brackets capture the costs of increased capacity in period 2. These costs are current expenditures and depreciation in period 2,  $\delta + b$ , and period 3,  $(1 - \delta)(\delta + b)$ , less the matching grant in period 2 ( $mb$ ).

The first order condition for the local government's resource allocation becomes:

$$u_{A1} = u_{A2} = u_{A3} = \frac{u_{B1}}{\delta + b} = \frac{u_{B2} + (1 - \delta)u_{B3}}{(2 - \delta)(\delta + b) - mb} \quad (5)$$

The last term captures that the capacity choice in period 2 is based on a utility-cost evaluation over periods 2 and 3. To simplify the discussion of the effects we assume that the intratemporal utility function is separable in  $A$  and  $B$ .

The impact of the matching grant for current expenditures can be separated into a substitution effect and an income effect. The income effect reflects that local government revenue increases and works as a block grant increase. The substitution effect works to increase the provision of service  $B$  in periods 2 and 3, to reduce the provision of service  $A$  in periods 2 and 3, and to reduce the provision of both services in period 1. The substitution effect implies an unintended consequence of the action plan: An announcement of a future matching grant reduces current service provision because future provision becomes relatively less expensive (intertemporal substitution effect).

Both the income and the substitution effect works to increase the provision of service  $B$  in periods 2 and 3. Otherwise the income and substitution effects will work in opposite directions. The net effect depends on the price elasticity of demand for service  $B$ . The income effect (substitution effect) dominates if demand for service  $B$  is inelastic (elastic). Most empirical studies tend to find that demand for local public services is inelastic. Provision of service  $A$  will be stable over time given that the intratemporal utility function is separable.

With inelastic demand provision of both services will increase in period 1. Moreover, since costs increases without an increase in revenues, the operating surplus will be reduced in period 1. The same argument holds for period 3, except that the surplus reduction will be larger because of the further capacity increase in period 2. In period 2 the surplus will increase because the revenue increase is also used to finance increased service provision in periods 1 and 3.

*Grant program 2: Announced investment grant in period 2*

An investment grant for period 2 means that the central government finances a fraction of investment spending in period 2. The budget constraint of the local government with binding non-negative constraint becomes:

$$R_1 + R_2 + R_3 = A_1 + A_2 + A_3 + [\delta + b + m(1 - \delta)]K_1 + [(2 - \delta)(\delta + b) - m]K_2 \quad (6)$$

The corresponding first order condition is:

$$u_{A1} = u_{A2} = u_{A3} = \frac{u_{B1}}{\delta + b + m(1 - \delta)} = \frac{u_{B2} + (1 - \delta)u_{B3}}{(2 - \delta)(\delta + b) - m} \quad (7)$$

As the matching grant for current expenditures, the investment grant works to reduce the costs of increased capacity in period 2. This is captured by the second bracket on the right hand side of equation (7), and has the same qualitative effect as the matching grant for current expenditures discussed above. However, it is evident that investment grant also affects the relative price of increased capacity in period 1. It actually makes investments in period 1 more expensive. The reason is that high investments in period 1 make it more difficult to take advantage of the action plan in period 2. Compared to the matching grant for current expenditures, it is more likely that an investment grant reduces the provision of service  $B$  in period 1.

The total effect of the investment grant on service  $B$  is that service provision will go up or down in period 1, that it will increase in period 2, and be reduced in period 3 in tandem with the depreciation of the capital stock. The impact on service  $A$  is ambiguous, but service provision will be stable over time given the separability assumption.

Under the assumption of inelastic demand for service  $B$  we concluded that a matching grant for current expenditures would reduce the surplus in period 1 and 3, and increase it in period 2. With an investment grant the effects are more ambiguous. But compared to a matching grant for current expenditures, the surplus will be higher in period 1 (because provision of service  $B$  will be less) and lower in periods 2 and 3 (capacity is likely to be increased to a

higher level in period 2).

*Grant program 3: Surprising investment grant in period 2*

The investment grant analyzed above were effective in period 2, but were announced and known by the local government already at the beginning of period 1. This timing of events is the key to understand why the investment grant may reduce provision of service  $B$  in period 1. Alternatively the investment grant may come as a surprise, i.e. the grant program is announced at the beginning of period 2. A surprising grant program will (by definition) not affect capacity and service provision in period 1, but will have an impact in periods 2 and 3. The local government will revise its decision at the beginning of period 2 based on the following budget constraint:

$$R_2 + R_3 - m(1 - \delta)K_1 = A_2 + A_3 + [(2 - \delta)(\delta + b) - m]K_2 \quad (8)$$

Equation (8) assumes that the point of departure is stable block grant financing with budgetary balance in period 1, and also that the non negative investment constraint is active in period 3. The term within the brackets captures that the costs of capacity build up in period 2, and it appears that the investment grant works to reduce the costs of increased capacity. The investment grant has an additional effect through the last term on the left hand side of equation (8). This effect captures that the grant program only comprises gross investments made in period 2. For a given choice of capacity in period 2, the received investment grant is lower the higher the capacity in period 1. High investments in period 1 make it more difficult to take advantage of the grant program, which in the case of a surprising investment grant has a negative income effects for periods 2 and 3.

The first order conditions for periods 2 and 3 are as follows:

$$u_{A2} = u_{A3} = \frac{u_{B2} + (1 - \delta)u_{B3}}{(2 - \delta)(\delta + b) - m} \quad (9)$$

It appears that the investment grant works to increase capacity and provision of service  $B$  in period 2. In period 3 capacity and provision of service  $B$  is adjusted downward in tandem with the depreciation, but the higher level is to a large extent maintained.

For service  $A$  there will be the standard substitution and income effects associated with a cost reduction for service  $B$ . But a surprising investment grant will in addition have a negative income effect reflecting that the local government made the period 1 capacity choice without knowing that an investment grant would be implemented in period 1. Compared to an announced investment grant, it is therefore more likely that a surprising investment grant will reduce provision of service  $A$  in periods 2 and 3. With an announced investment grant the capacity build up in period 2 is partly financed by investing less in period 1. With a surprising investment grant this option is lost, and consequently the expansion of service  $B$  will have additional negative effects for the provision of service  $A$  in periods 2 and 3.

#### 4. Simulations

In this section we present some simulations in order to illustrate how the grant programs affect service provision and budgetary surplus. The simulations are based on the following Cobb-Douglas utility function

$$u(A_t, B_t) = \alpha \log A_t + (1 - \alpha) \log B_t \quad 0 < \alpha < 1 \quad (10)$$

where  $\alpha$  is assumed to be 0.7. Moreover, the depreciation rate is set to 0.05 and the parameter  $b$  is set to 0.45.

Table 1: Simulation results

	$A_1$	$A_2$	$A_3$	$B_1$	$B_2$	$B_3$	$SURPL_1$	$SURPL_2$	$SURPL_3$
Stable block grant financing	70	70	70	60	60	60	0	0	0
Increased block grant in period 2	73,5	73,5	73,5	63	63	63	-5	10	-5
Announced matching grant for current expenditures in period 2	70	70	70	60	76,9	73,1	0	6,5	-6,5
Announced investment grant in period 2	70	70	70	38,6	87,9	83,5	10,7	1,0	-11,7
Surprising investment grant in period 2	70	61,8	61,8	60	93,7	89,0	0	6,3	-6,3

Table 2: Myopic behavior

	$A_1$	$A_2$	$A_3$	$B_1$	$B_2$	$B_3$	$SURPL_1$	$SURPL_2$	$SURPL_3$
Stable block grant financing	70	70	70	60	60	60	0	0	0
Increased block grant in period 2	70	80,5	67	60	69	65,6	0	0	0
Matching grant for current expenditures in period 2	70	70	57,3	60	90	85,5	0	0	0
Investment grant in period 2	70	59,1	46,9	60	111,8	106,3	0	0	0

The simulation results are displayed in Table 1. The point of departure is stable block grant financing where the block grant equals 100 in each period. It appears that the local government chooses stable provision of both services; 70 units of service *A* and 60 units of service *B*. Capacity investment at the beginning of period 1 is 60, and the beginning of periods 2 and 3 the local government invests 3 in order to maintain capacity. There is budgetary balance in each period.

As a benchmark we first report the impact of a block grant increase of 15 in period 2, which amounts to a 5% increase in revenues over the three periods. The positive income effect leads to increased provision of both services by 5% in all three periods. The equal percentage increase for the two services reflects that Cobb-Douglas utility yields income elasticity of unity for both services. With a more general utility function the percentage increase in service provision would vary across the two services. The block grant program works to increase the budgetary balance in period 2, and to increase it in periods 1 and 3.

The matching grant programs are all calibrated such that the revenue increase in period 2 is 15. The associated matching rates are 43% for the announced matching grant for current expenditures, 29% for the announced investment grant, and 41% for the surprising investment grant.

The announced matching grant for current expenditures expands the provision of service *B* in periods 2 because of the reduced unit cost, and the increased provision is to a large extent maintained in period 3. The provision of service *A*, as well as the provision of service *B* in the first period, is not affected by the grant program. The reason is that the direct price elasticities are -1 with Cobb-Douglas utility, implying that the income and substitution effects discussed in the general case cancel each other out. With price inelastic demand, as confirmed by most empirical studies, there would be some leakage towards service *A* in all three periods. In addition, provision of service *B* would increase already in period 1.

The matching grant for current expenditures leads to a budgetary surplus in period 2 and a deficit in period 3, reflecting that local government resource use increases in period 3. The budgetary balance in period 1 is not affected. The reason is that service provision in period 1

is not affected, which is due to price elasticities of -1. With inelastic demand service provision would increase in period 1, leading to a budget deficit in period 1.

The announced investment grant contributes to lower provision of service *B* in period 1 and to increased provision in periods 2 and 3. The reduction in period 1 reflects that is beneficial to postpone some of the capacity build up to period 2, in which investments are subsidized through the grant program. It is interesting to notice that the total provision of service *B* over the three periods is the same as for the announced matching grant for current expenditures. However, the investment grant has the disadvantage of providing a more unstable service provision. An announced investment grant leads to a budgetary surplus in period 1 and a deficit in period 3, while the budgetary balance in period 2 is not much affected.

By definition, a surprising investment grant does not affect service provision in period 1, but increases the provision of service *B* in periods 2 and 3. The total provision of service *B* over the three periods is larger than for the announced matching grants.<sup>1</sup> In contrast to the announced matching grant programs, the surprising investment grant reduced provision of service *A* in periods 2 and 3. The reason is the negative income effect from being unable to hold back investments in period 1. The surprising investment grant increases the budgetary balance in period 2 and decreases it in period 3, reflecting that the increased resource use is spread over the two periods.

## 5. Myopic behavior

The analysis in section 3 and the simulations in section 4 assume that local governments are rationally and forward-looking. When they invest to increase capacity, they take fully account of the future costs (depreciation and running expenditures) of increased capacity. In the public debate on temporary grant programs this assumption has been questioned. It has rather been argued that local governments overinvest while the grant program is in place without taking sufficiently account of the future costs.

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<sup>1</sup> The expansion is also larger compared to a surprising matching grant for current expenditures. In our simulations the impacts of announced and surprising matching grant for current expenditures will be the same.

As a starting point we model myopic behavior by static maximization of the intratemporal utility function given a requirement of budgetary balance. Budgetary balance is defined according to equation (6). With myopic behavior none of the grant programs will affect service provision in period 1 or the budgetary surplus. As with rational forward-looking behavior, we assume full capacity utilization in the provision of service  $B$  in period 3.

The simulation results with myopic behavior are displayed in table 2. Three grant programs are analyzed; (i) a block grant increase in period 1, (ii) a matching grant for current expenditures in period 2, and (iii) an investment grant in period 2. The impact of myopic behavior is similar for all three grant programs, and can be seen by comparing with table 1. It appears that myopic behavior leads to larger capacity investments in period 2, and thereby a higher provision of service  $B$  in periods 2 and 3. Because of overinvestment in period 2 and the requirement of budgetary balance in period 3, there will be cutbacks in the provision of service  $A$  in period 3. The impact of myopic behavior on the provision of service  $A$  in period 2 varies across the grant programs. Myopic behavior increases  $A_2$  under the block grant program, reduces it under the investment grant, while it is not affected under the matching grant for current expenditures.

The budgetary balance is by assumption not affected by the simulations in table 2. The requirement of budgetary balance is reasonable in the long term, but may hide some interesting transitory dynamics. In the short term local governments may find it difficult to reduce the provision of service  $A$  sufficiently to obtain budgetary balance, and the immediate effects of abolishing the grant program may therefore be a combination of cutbacks in the provision of service  $A$  and a budget deficit. And given overinvestment in service  $B$ , it is less likely that the local governments will find it optimal to utilize all capacity after the grant program is finished.

## **6. Discussion and concluding remarks**

We have formulated a two good, three period model to analyze the impacts of temporary

grant programs for service provision and budgetary balance. The model separates between three periods (before, during, and after the grant program) and different grant programs (block grant, matching grant for current expenditures, and investment grant). From the point of view of the central government the purpose of the grant programs is to increase the provision of a particular service (the central government preferred service). Compared to the existing literature on dynamic fiscal behavior and grants we treat the case of two competing services.

As a benchmark we analyze the impacts of a block grant program. The block grant program leads to immediate increase in the provision of the prioritized service and stable service provision over time, while the disadvantage is leakage to other services. Matching grant programs are motivated by this leakage, and matching of current expenditures and investments are more efficient in stimulating the centrally preferred service. The cost is a stronger shift in allocation between the two services and more unstable service provision over time. The investment grant results in more instability than the matching grant for current expenditures by providing incentives to reduce investments in the prioritized service before the grant program is implemented.

The simulations indicate that the matching grant for current expenditures is superior to the investment grant since it provides more stability over time and the same expansion of the prioritized service. However, this conclusion is not robust to alternative assumptions. If the investment grant comes as a surprise, it will give a larger expansion of the prioritized service and less instability over time since there is no strategic reduction in investments in the prioritized service before the grant program is implemented. Myopic behavior may also increase the relative effectiveness of investment grants in terms of increasing the provision of the prioritized service.

All grant programs tend to increase the budgetary surplus during the grant program and to reduce it after the grant program. This reflects that some of the grant increase is saved and used to finance increased service provision also in later periods. The announced investment grants stands out by only leading to a slight increase in the budgetary balance under the grant program and a substantial increase before. Under the announced investment grant it is optimal to hold back on current expenditures and investments in the prioritized service to be in a

better position to take advantage of the grant program.

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## Appendix: Budget constraints

The intertemporal budget constraint of the benchmark model can be written as

$$R_1 + R_2 + R_3 = A_1 + A_2 + A_3 + bK_1 + bK_2 + bK_3 + I_1 + I_2 + I_3 - (1 - \delta)K_3 \quad (\text{A1})$$

where  $bK_t$  is current expenditures for service  $B$  and  $(1 - \delta)K_3$  is the revenues from selling the capital stock at the end of period 3. Current expenditures per unit of service  $A$  is normalized to unity such that  $A_t$  indicates the level of service provision in period  $t$ . By utilizing the relationship between gross investment and capacity, the budget constraint reads:

$$R_1 + R_2 + R_3 = A_1 + A_2 + A_3 + (\delta + b)K_1 + (\delta + b)K_2 + (\delta + b)K_3 \quad (\text{A2})$$

The present value of block grants (the left hand side) is equal to the present value of the costs of service provision. Production of service  $B$  requires both capital and current expenditures, and the cost per unit of  $B$  is  $\delta + b$  in all periods.

A matching grant for current expenditures in period 2 means that the central government finances a fraction of current expenditures for service  $B$ . The intertemporal budget restriction can be written as

$$R_1 + R_2 + R_3 = A_1 + A_2 + A_3 + bK_1 + (1 - m)bK_2 + bK_3 + I_1 + I_2 + I_3 - (1 - \delta)K_3 \quad (\text{A.3})$$

where  $m$  is the fraction of current expenditures financed by the matching grant. By utilizing the relationship between investments and capacity, the budget restriction can be rewritten as:

$$R_1 + R_2 + R_3 = A_1 + A_2 + A_3 + (\delta + b)K_1 + [\delta + (1 - m)b]K_2 + (\delta + b)K_3 \quad (\text{A.4})$$

Assuming non-negative gross investments in period 3 we reach the budget constraint (4) in the text.

An investment grant for period 2 means that the central government finances a fraction of investment spending in period 2:

$$R_1 + R_2 + R_3 = A_1 + A_2 + A_3 + bK_1 + bK_2 + bK_3 + I_1 + (1-m)I_2 + I_3 - (1-\delta)K_3 \quad (\text{A.5})$$

By utilizing the relationship between investments and capacity and assuming that the non-negative constraint is binding, the budget restriction (6) in the text follows.