Time consistency and bureaucratic budget competition*

Sebastian G. Kessing† and Kai A. Konrad‡

February 27, 2007

Abstract

*We thank participants at a workshop in Rotterdam 2005, the EEA meeting 2005 in Amsterdam, the Public Economics Meeting 2005 in Palma, the PET conference 2005 in Marseille, the CESifo EPS area conference 2006, the ESF-CEPR conference in Bristol 2006, and at a seminar at Mannheim, Sascha Becker, Christian Dustmann, Leonardo Felli, Daniel Ferreira, Patrick Francois, Roland Strausz and two anonymous referees for very useful comments. The usual caveat applies. Konrad gratefully acknowledges financial support from the Deutsche Forschungsgemeinschaft through SFB/TR 15. Kessing gratefully acknowledges financial support from the Anglo-German Foundation through the CSGE research initiative.

†Social Science Research Center Berlin (WZB).

‡Social Science Research Center Berlin (WZB) and Free University of Berlin. Correspondence to: Kai A. Konrad, WZB, Reichpietschufer 50, D-10785 Berlin, Germany. Phone: ++49-30-25491-402, fax: ++49-30-25491-400, e-mail: kkonrad@wz-berlin.de.

High employment protection in the public sector results in strategic over-employment if government divisions compete for budgets in a dynamic setting. Bureaucrats who are interested in maximising their divisions' output employ excess labor, since this induces the sponsor to provide complementary inputs in the future. Restrictions on hiring decisions in the public sector can be regarded as provisions to reduce strategic hiring. We also provide evidence from a survey of decision makers in a public sector bureaucracy with very high employment protection. The results confirm that decision makers are aware of the strategic effects of their hiring decisions on budget allocation.

Keywords: bureaucratic competition, strategic hiring, labor intensity, public sector

JEL classification numbers: H11, H61, H83

1 Introduction

Public employees and civil servants enjoy very high employment protection. This holds, in particular, in many European countries where workers in the public sector effectively enjoy lifelong tenure once they have been hired.[1] Such provisions turn labour into a fixed factor. Based on this observation, we develop a theory of strategic hiring in the public sector. Bureaucrats

who compete for centrally allocated budgets can exploit the durability of tenured labour and tend to strategically over-employ.

The key to our argument is the complementary nature of productive inputs. Over-hiring tenured labour today increases a division's fixed wage bill tomorrow, leaving fewer resources for other complementary inputs. This distortion makes the under-used complementary inputs more productive at the margin. Output-interested bureaucrats will spend all additional funds received by their division on these complementary inputs. Since these additional funds are very productive, in a situation of budget competition between divisions, a central sponsor has an incentive to allocate more funds to overstaffed divisions tomorrow. Bureaucrats who are only interested in their own division foresee this incentive and resort to strategic hiring today.

Strategic hiring is a relevant problem in practice. First, particular budget rules that shift hiring decisions to the upper levels in the bureaucracy and specify the break-up of budgets into spending categories are widespread, particularly in the public sector (Heymann, 1988; Senf, 1977). Our analysis can explain why they exist, contributes to the current debate on specific versus global budgets in favour of the former rules, and relates to the relationship of formal and real authority (Aghion and Tirole, 1997).

Second, strategic hiring is consistent with empirical evidence on inter-

governmental fiscal relations. The number of public employees at subnational levels has significant positive effects on grant transfers from central governments to these levels.[2] Gimpelson and Treisman (2002) provide empirical evidence from Russia, on how regional public employment has been used by regional authorities to extract higher grants from the central government. They also provide a strategic theoretical perspective, but rely on wage arrears at the regional level that create political unrest, which puts pressure on the central government. Thus, their approach operates via the political system and, as they stress, is more appropriate for countries with weak institutions. Our strategic approach, based on tenure in the public sector, is more direct and more widely relevant.

Third, strategic hiring is consistent with the well-documented higher labour intensity in the public sector (see, for evidence, e.g., Dewenter and Malatesta, 2001). Intuitively, strategic hiring takes place where hiring decisions yield strategic commitment and leads to excessive hiring in the equilibrium. Since employment protection is much lower in the private sector, the potential of using tenured labour strategically is much reduced or absent. Thus, ceteris paribus, labour intensity should be lower in the private sector.[3]

Finally, we have some direct evidence on the perceptions of decision

makers in bureaucracies on strategic hiring. We conducted a survey of all full-time professors at the University of Hamburg, a public German university, in March 2006.[4] Public universities in Germany are characterized by extremely high employment protection. Almost all professors are civil servants for life and cannot be fired even if the whole department or the whole university is closed. We asked questions related to the filling of vacated professorships, since this is the most important form of hiring in the university system. A summary of the results is given in figure 1. First, 81.9% of the respondents think that their department has an influence on the replacement of a professorship (85.9% if invalid answers and "Don't know" answers are left out).[5] More importantly, 96.2% (99.1%) of the them think that the replacement decisions for vacated professorships are of strategic importance for the continuity and future development of the department and of the courses offered. 57.1% (63.6%) believe that the replacement of vacated professorships leads to more overall resources for the department in the medium run, compared to not replacing them. Similarly, 70.2% (75.9%) disagree with the claim that hiring reduces the department's overall resources, 57.6% (62.6%) disagree with the claim that hiring tenured professors reduces non-tenured researchers in the department, and 73.1% (76.3%) disagree with the claim that not hiring tenured staff increases the resources for each tenured profes-

sor. All results are highly significant using standard non-parametric tests. For example, with the given aggregation, a standard binomial test of whether respondents' answers do not support strategic hiring with a probability of 0.5 or higher can be rejected at the 1% level for all relevant questions. Similarly, chi-square goodness of fit tests with hypothesized symmetric distributions for all four answer categories are rejected at the 1% level. In summary, respondents are very aware of the strategic role of tenured hiring decisions for the department and its future resources.

Figure 1 here

We also asked whether there had been an increase or decrease in the overall budget, in the number of tenured professorships and in the number of short-term employees both in absolute numbers and in employees per capita of tenured professors in the department, compared to 8 years ago. The survey shows that the reduction in overall resources of a department is positively correlated with the reduction in the number of tenured professors, and that the change in the number of short term employees is also positively correlated with the change in the number of professors.[6] On the other hand, the change in the number of professors is not correlated with the change of the average endowment of each tenured position with non-tenured labour.[7]

These correlations suggest that tenured professorships and other inputs are complements. This will be an important element for a theory of strategic hiring.

Little to nothing is known empirically about the determinants of hiring decisions in the public sector. Evidence is either anecdotal (Gelb et al., 1991), at the macro-level (Rodrik, 2000), or indirect (Lopez-de-Silanes et al., 1997). On the one hand, this lack of empirical evidence is due to a lack of appropriate data. On the other hand, existing theories of public sector hiring suffer from the problem that they do not provide sufficiently sharp predictions that would allow to discriminate between them. For example, Lopez-de-Silanes et al. (1997) find significant effects of a number of political and institutional variables on contracting out of US counties, but must admit that they are unable to discriminate between different theoretical approaches which can all explain their empirical results. Contrary to existing theories, our theoretical perspective provides an empirical prediction that is not shared by other explanations of public sector hiring policies. In particular, according to our perspective, strategic hiring should not be observed if bureaucrats expect their budgets to increase sufficiently in the future.

Our theory of strategic hiring is closely linked to two strands of the literature and can be seen as a contribution to both. First, a considerable

amount of work on political economy discusses the importance of decisions with a lasting impact on future elections, and the significance of these decisions for the decision making of future governments. For instance, Persson and Svensson (1989) discuss the commitment effects of government debt for future governments. More directly related to our analysis, Glazer (1989) discusses the use of durable projects and how the choice of the durability of a project may affect future election outcomes and future policy decisions. Crain and Oakley (1995) test this theory indirectly, confirming that political institutions that affect the political sustainability of policy choices have an impact on infrastructure spending. The common link between these analyses and this paper is that durability yields commitment, and, hence, becomes a strategic instrument.

Second, our analysis of budget competition is closely related to the literature on bureaucracy. Starting with Niskanen (1971), this literature has been growing fast, see, e.g., Kraan (1996) for an overview. Much of the literature considers the static problem, but some earlier work also addresses multi-period issues, such as Carlsen and Haugen (1994) or Bagnoli and McKee (1991). A central focus of this literature is on how to control the bureaucrat who has an incentive to earn some rent from reduced effort. We consider bureaucrats whose production opportunities are perfectly known, so

that actual slack, or agency rents from private information, can be avoided. Our paper is closely related to Moene (1986) and Chan and Mestelman (1988), who consider the strategic interaction between one bureaucrat and his sponsor. Moene (1986), for instance, considers timing of decision making between a bureau and the sponsor, where the bureau may try to trigger higher payments by generating a high expenditure bill. Competition among bureaucrats has also been considered in the literature by Bagnoli and McKee (1991). They argue that such competition can be used as a disciplinary device. We show that, given the discretion of the bureaucrats in early periods, the inefficiency emerges here precisely *because* of the competition between divisions.

We proceed as follows. In section 2, we outline our analytical framework. In section 3, we characterize the efficiency benchmark case. In section 4, we derive the main results on the role of tenured labour as a strategic instrument. Section 5 discusses our results and draws policy conclusions.

2 The analytical framework

Consider a simple two period framework of a government with a bureaucracy that consists of divisions $i = x, y$. The government has an overall budget B_t

for each period $t = 1, 2$ and divides this between the two divisions such that

$$B_t = b_{xt} + b_{yt} \tag{1}$$

in each period, where b_{it} denotes division i's budget in the respective period t. Each division is headed by a bureaucrat who freely allocates the bureau's budget between two input factors, one of which is durable, and whose quantity is used in period t by division i. The quantity of this input is denoted l_{it}. We call the durable factor *tenured labour*. The other factor is non-durable. Its quantity is denoted z_{it}. This factor describes inputs such as paper, pencils, electricity, rented office space, or even durable goods that can, however, be sold at the end of a period.

We consider a partial model in which the governmental sector is only a small part of the whole economy so that the factor input choices in the divisions do not affect equilibrium factor prices, and we normalize all factor prices to unity. The assumption of fixed wages is particularly plausible for the public sector as wages are typically negotiated centrally and workers are classified into a rigid wage structure which leaves minimal discretion to division heads within the bureaucracy. The budget constraint of the bureaucrat in division i in period t can be written as

$$b_{it} \geq l_{it} + z_{it} \text{ for } t = 1, 2, \tag{2}$$

and expenditure on l_{it} and z_{it} are chosen by the division's bureaucrat at the beginning of each respective period once the size b_{it} of the period budget is known to the division.

As the civil servants are tenured, employment decisions made in period $t = 1$ have a lasting impact on employment in period $t = 2$. We will describe this with the constraint

$$l_{i2} \geq \min\{l_{i1}, b_{i2}\}. \tag{3}$$

This constraint states that no civil servant can be fired if the current budget is sufficiently large to pay the wage bill. For completeness, (3) also states what happens if the period-2 budget of a division is smaller than the wage bill of the set of civil servants who were hired in period 1. We assume that, in this case, the division has to spend all its budget on the wage bill, and nothing on the variable factor of production.

Turn now to the outputs x_t and y_t of the divisions. Output is produced by a standard twice continuously differentiable time invariant production function

$$x_t = f(l_{xt}, z_{xt}) \text{ and } y_t = f(l_{yt}, z_{yt}), \tag{4}$$

with $f(0, z) = f(l, 0) = 0$, and with first and second partial derivatives $f_l > 0,\ f_z > 0, f_{ll} < 0,\ f_{zz} < 0$. Symmetry of the divisions in terms of their production technologies is mainly for notational parsimony. A key

assumption as regards f is $f_{lz} > 0$ as, together with the tenure constraint (3), this complementarity will make high commitments to labour a useful strategic choice from the point of view of the bureaucrat.

We now turn to the objective functions of the government and of the bureaucrats. The government positively values divisions' output and negatively values their expenditures. But, as the aggregate expenditure of the government is exogenously given here, we can disregard this element in the objective function. The government's objective function can therefore be written as

$$G = G_1 + G_2 \text{ with } G_t = G(x_t, y_t), \tag{5}$$

which is symmetric, $G(x, y) = G(y, x)$, with $G(x, 0) = G(0, y)$, and has partial derivatives $\partial G_t/\partial x_t > 0$, $\partial G_t/\partial y_t > 0$, $\partial^2 G_t/(\partial x_t)^2 \leq 0$, $\partial^2 G_t/(\partial y_t)^2 \leq 0$, and $\partial^2 G_t/(\partial x_t \partial y_t) \geq 0$ for all (x, y) with $\min\{x, y\} > 0$. The concavity of G in each output maps the idea that a government is responsible for supplying a mix of outputs. If outputs are perfect substitutes, a government will typically avoid the inefficient budget competition of different bureaus by eliminating all but one of these bureaus. Symmetry is again for simplicity only.

The government's objective function may represent its constituency's preferences more or less well. Since we focus on the incentive problems be-

tween the government and the bureaucracy, we disregard any agency problems between the politician and his constituency and consider the objective function (5) to be the measure of efficiency.

Finally, we consider the objective functions of the chief bureaucrats of the divisions. The theory of bureaucracy that was briefly discussed in the introduction provides a diversity of possible assumptions about what bureaucrats may care about, but what all these assumptions have in common is that the bureaucrat cares about his own division, maybe its size or its output etc. A simple assumption that is plausible and more generally in line with bureaucracy theory is that the chief bureaucrat of division i cares about the total output of his division,

$$x = x_1 + x_2 \text{ and } y = y_1 + y_2. \tag{6}$$

These objective functions are taken as given. From a contract theory perspective, the framework is one in which the set of feasible contracts is very limited: the central government can allocate a fixed budget, and the division head can use it to produce according to his own preferences, which cannot be affected further by the central government with contractual arrangements for reasons outside the scope of this analysis. But, as evident from (5) and (6), the preferences of the division head are partially aligned with those of the government.

The more balanced preferences of the government could, for instance, be due to considerations about the preferences of their constituency and the government's concerns about re-election, but for brevity are taken as given here (5). Note that the objective functions of the government and the bureaucrat implicitly assume (for simplicity) equal weight given to both periods.

3 Efficiency

Consider the efficient allocation as a benchmark case. For convenience, denote efficient quantities by respective Greek letters. Define $\lambda(b)$ and $\zeta(b) = b - \lambda(b)$ as the production cost efficient inputs of l_{it} and z_{it}, respectively, if the division's budget is b in the respective period. They have no subscripts because they are invariant with respect to time or division, as the production function f is not division specific and is time invariant. For given b, these quantities are determined by the marginal condition

$$\frac{\partial f(\lambda(b), b - \lambda(b))}{\partial l} = \frac{\partial f(\lambda(b), b - \lambda(b))}{\partial z}. \tag{7}$$

Using the symmetry assumption of G, the efficient allocation can be characterized as follows.

Proposition 1 *For $B_2 \geq B_1$, the allocation that maximizes the value of*

the objective function of the government is characterized by $b_{it} = \frac{B_t}{2}$ *, and* $l_{it} = \lambda(\frac{B_t}{2})$ *as determined in (7),* $x_t = y_t = f(\lambda(\frac{B_t}{2}), \frac{B_t}{2} - \lambda(\frac{B_t}{2}))$.

A formal proof is omitted. The proposition states that the efficient solution requires production efficiency in both periods and in all divisions, and this is described by the optimal factor input mix for a given budget. For given budgets, this also determines the efficient labour intensity, $\frac{\lambda}{b-\lambda}$.

Throughout the analysis, we assume $B_2 \geq B_1$ and disregard the possibility of a squeeze of the total budget, although a budget squeeze is interesting as well. For $B_2 < B_1$, a second-best problem emerges and adds complexity: in the case of a budget squeeze with tenured civil servants, the first-best equilibrium that is characterized in Proposition 1 cannot be attained. The labour intensity that is first-best in period 1, if chosen, induces an inefficiency in period 2: the period-2 budget is too small to finance both, a labour choice larger or equal to the period-1 choice and the efficient amount of the variable input that comes together with this labour choice. It will also generally require optimally less labour to be employed in period 1 than would be optimal for the static period-1 problem taken in isolation. Accordingly, for a budget squeeze, the efficiency benchmark becomes more difficult, and the comparison between the efficient outcome and the equilibrium outcome becomes less transparent than for the case in Proposition 1. The analysis

of a budget squeeze would, however, reveal that the strategic incentive to over-hire civil servants in an early period is also at work if a squeeze of the overall budget is anticipated.

4 Equilibrium

Consider the time structure of decisions. In period 1, in a STAGE 0, the government decides how to split the available budget B_1 among the divisions. The choice can be described in general by some vector $\mathbf{b}_1 \equiv (b_{x1}, b_{y1})$ for which (1) holds. For an analysis of the strategic incentives of the divisions of the bureaucracy, we assume that the government splits the budget evenly between the two divisions in period 1, with $b_{x1} = b_{y1} = B_1/2$ as the reference point, as this is what would happen in the efficiency benchmark case in Proposition 1. In STAGE 1, the bureaucrats decide on l_{i1} and z_{i1}, subject to the budget constraint (2). Then the period outputs accrue and period 1 ends. In period 2, first, in STAGE 2, the government allocates B_2 to the divisions, and the allocation chosen is described by a vector $\mathbf{b}_2 \equiv (b_{x2}, b_{y2})$ for which (1) holds. Then, in STAGE 3, the bureaucrats choose how to spend their budgets on l_{i2} and z_{i2}, subject to the budget constraint (2) and the labour constraint (3). Finally, output accrues and the game ends.

Proposition 2 *Let $B_1 = B_2 \equiv B$, and let $b_{x1} = b_{y1} = B/2$. Then, in any symmetric equilibrium in pure strategies in which both divisions produce positive output, $l^*_{i1} = l^*_{i2} > \lambda(\frac{B}{2})$. Outputs in both periods in both divisions are smaller than the efficient quantities.*

Proof. For a proof, first consider STAGE 3 in period 2. The equilibrium choice of i's period-2 labour input is

$$l^*_{i2} = \begin{cases} l_{i2} = b_{i2} & \text{if} \quad b_{i2} < l_{i1} \\ l_{i2} = l_{i1} & \text{if} \quad b_{i2} \in [l_{i1}, \beta(l_{i1})) \\ l_{i2} = \lambda(b_{i2}) & \text{if} \quad b_{i2} \geq \beta(l_{i1}) \end{cases} \tag{8}$$

for $i = x, y$. It is a function of labour input in period 1 and of the division budget in period 2, where $\beta(l_{i1})$ is defined by the condition $\lambda(\beta(l_{i1})) = l_{i1}$.

Equation (8) makes use of the fact that the division maximizes output in period 2, choosing factor inputs as close to the efficient input combination as possible, but respects the tenure constraint (3). Accordingly, the output in STAGE 3 is also determined jointly by employment in period 1 and by the size of the division's budget in period 2, and is equal to

$$x^*_2 = f(l^*_{x2}, b_{x2} - l^*_{x2}) \text{ and } y^*_2 = f(l^*_{y2}, b_{y2} - l^*_{y2}). \tag{9}$$

Turning now to the budget allocation decision in STAGE 2 at the beginning of period 2, the government chooses $\mathbf{b_2}$ to maximize $G(x^*_2, y^*_2)$ subject

to (1) for $t = 2$, with x_2^* and y_2^* defined in (9). If $l_{x1} + l_{y1} \geq B_2$, then $G_2 = 0$ is implied for all possible allocations of the budget among the two divisions, and we assume that the government chooses $\mathbf{b}_2$ in this case such that also $x_2^* = y_2^* = 0$.[8] If $l_{x1} + l_{y1} < B_2$, then the government maximizes G_2 and can and will avoid the minimum payoff $G_2 = 0$ by making $b_{i2} > l_{i1}$ for both divisions $i = x, y$. On the basis of the assumptions about f, this maximum is reached at the point where

$$\Theta_2 \equiv \frac{\partial G_2}{\partial x_2}\frac{\partial x_2^*(b_{x2}, l_{x1})}{\partial b_{x2}} - \frac{\partial G_2}{\partial y_2}\frac{\partial y_2^*(b_{y2}, l_{y1})}{\partial b_{y2}} = 0. \tag{10}$$

This describes the equilibrium in the continuation games for any given $\mathbf{l}_1$. Turning now to STAGE 1, consider the marginal incentives of the head of division x who anticipates a given choice of l_{y1} by division y and anticipates the equilibrium paths in the continuation game for stages 2 and 3. The marginal condition that determines the payoff increase from an increase in l_{x1} (taking into consideration that $z_{xt} = b_{xt} - l_{xt}$) is

$$\frac{\partial(x_1 + x_2)}{\partial l_{x1}} = \frac{\partial x_1}{\partial l_{x1}} - \frac{\partial x_1}{\partial z_{x1}} + \frac{\partial x_2^*}{\partial l_{x1}} + \frac{\partial x_2^*}{\partial b_{x2}}\frac{db_{x2}}{dl_{x1}}. \tag{11}$$

Let $B_1 = B_2 \equiv B$ and $b_{x1} = b_{y1} = \frac{B}{2}$. For any $l_{x1} = l_{y1} < \lambda(\frac{B}{2})$, the last two terms on the right-hand side in (11) are zero, as (3) will be non-binding, and $\frac{\partial x_1}{\partial l_{x1}} > \frac{\partial x_1}{\partial z_{x1}}$. Accordingly, $l_{x1} < \lambda(\frac{B}{2})$ is suboptimal from the perspective of division x, and analogously for division y.

Further, for $l_{x1} = l_{y1} = \lambda(\frac{B}{2})$, $\frac{\partial x_1}{\partial l_{x1}} = \frac{\partial x_1}{\partial z_{x1}}$. Moreover, $\frac{\partial x_2^*}{\partial l_{x1}} = 0$. At the efficient input mix, the output does not change if one marginal unit of z_x is replaced by one marginal unit of l_x. Consider $\frac{\partial x_2^*}{\partial b_{x2}} \frac{db_{x2}}{dl_{x1}}$. Clearly, $\frac{\partial x_2^*}{\partial b_{x2}} > 0$. To consider the effect of a marginal increase in l_{x1} from $\lambda(\frac{B}{2})$ to slightly above $\lambda(\frac{B}{2})$ on b_{x2}, we differentiate the governmental optimality condition (10) totally with respect to l_{x1} and b_{x2} at $l_{i1} = \lambda(\frac{B}{2})$ for $i = x, y$, taking into consideration that $b_{x2} + b_{y2} = B$. We obtain

$$\frac{db_{x2}}{dl_{x1}} = -\frac{\frac{\partial \Theta_2}{\partial l_{x1}}}{\frac{\partial \Theta_2}{\partial b_{x2}}}.$$

In an interior equilibrium, $\frac{\partial \Theta_2}{\partial b_{x2}} < 0$ by the second-order condition for the budget allocation in period 2 to establish a local maximum of the government's payoff in period 2. The sign of $\frac{db_{x2}}{dl_{x1}}$ is therefore the same as the sign of

$$\frac{\partial \Theta_2}{\partial l_{x1}} = \frac{\partial^2 G_2}{(\partial x_2)^2} \frac{\partial x_2^*}{\partial b_{x2}} \frac{\partial x_2^*}{\partial l_{x1}} + \frac{\partial G_2}{\partial x_2} \frac{\partial^2 x_2^*}{\partial b_{x2} \partial l_{x1}} - \frac{\partial^2 G_2}{\partial y_2 \partial x_2} \frac{\partial x_2^*}{\partial l_{x1}} \frac{\partial y_2^*}{\partial b_{y2}}.$$

Now, $\frac{\partial x_2^*}{\partial l_{x1}} = 0$ at $B_1 = B_2 \equiv B$, $b_{x1} = b_{y1} = \frac{B}{2}$, and $l_{x1} = l_{y1} = \lambda(\frac{B}{2})$, and is negative for increasing l_{x1}. But

$$\frac{\partial G_2}{\partial x_2} \frac{\partial^2 x_2^*}{\partial b_{x2} \partial l_{x1}} > 0,$$

if evaluated at $\lim_{l_{x1} \searrow \lambda(b_{x2})}$. This can be confirmed as follows. First, $\frac{\partial G_2}{\partial x_2} > 0$. Second, using (8) and (9) we can calculate $\frac{\partial^2 x_2^*}{\partial b_{x2} \partial l_{x1}}$. Evaluating the result at $\lim_{l_{x1} \searrow \lambda(b_{x2})}$, we find that $\frac{\partial^2 x_2^*}{\partial b_{x2} \partial l_{x1}} = \frac{\partial^2 x_2^*}{\partial z_{x2} \partial l_{x2}} - \frac{\partial^2 f}{\left(\partial z_{x2}^*\right)^2} > 0$, since $\frac{\partial^2 x_2^*}{\partial z_{x2} \partial l_{x2}} =$

$f_{xz} > 0$ and $\frac{\partial^2 f}{\left(\partial z^*_{x2}\right)^2} < 0$, by the properties of the production function. This shows that $l_{x1} = l_{y1} = \lambda(\frac{B}{2})$ can not be a symmetric interior equilibrium either.

Inefficiency in the production of x and y is an implication of $l_{i1} = l_{i2} > \lambda(\frac{B}{2})$ in a symmetric equilibrium as this implies an inefficiently high labour intensity in both periods. As the total budget for factor inputs is exogenously given, it implies a reduction in x_t and y_t in both periods compared to the efficient output level. ■

The intuition for the proof is straightforward from condition (11) if this condition is evaluated at $B_1 = B_2 \equiv B$, $b_{x1} = b_{y1} = \frac{B}{2}$, and $l_{x1} = l_{y1} = \lambda(\frac{B}{2})$. At this point, an increase in l_{x1} has no first-order effects on x_1 or x_2, if the budget of the x-division remains unchanged, and does not change this division's payoff. However, such a change will increase l_{x2} above its first-best level in period 1. As this tends to increase the marginal product of z_{x2}, it makes it valuable for the government to shift the budget and to increase the budget of the x-division, which uses this budget increase in the factor z_x that has the increased factor productivity. Of course, both divisions are inclined to use period-1 labour as a commitment device, and, as the overall budget in period 2 is fixed, this will increase labour intensity in the equilibrium above the efficient level.

Budget competition by several bureaus is important for our result. If, for instance, there is only one bureau that produces x, and the government simply allocates an exogenously given budget B to this bureau in both periods, then this bureau chooses the efficient labour input $l_{x1} = l_{x2} = \lambda(B)$ in both periods.[9]

The proposition and its proof essentially state a negative result: an efficient choice of l_{i1} by both bureaucrats cannot be an equilibrium. To turn this into a more positive result, consider an example with $B_1 = B_2 \equiv B$, $G_t = \ln x_t + \ln y_t$, and with a Cobb-Douglas production technology in which both factors enter symmetrically, $f(l, z) = l^{1/2} z^{1/2}$. If the budget allocation in period 1 was $b_{x1} = b_{y1} = B/2$, then straightforward calculations show that the equilibrium in this case is characterized by

$$b_{i2} = \frac{B}{2},\ l_{i1} = l_{i2} = \frac{4B}{14},\ \text{and}\ z_{i1} = z_{i2} = \frac{3B}{14},$$

whereas an efficient allocation is characterized by $l_{i1} = z_{i1} = l_{i2} = z_{i2} = \frac{B}{4}$. This example shows that each bureau uses tenured labour in order to induce the government to allocate a higher budget share to this bureau. Both bureaus end up with equal budget shares in period 2, as their efforts just net out each other, and both bureaus produce with a labour intensity that is higher than what would be optimal, given the symmetry between the two factors in the production technology.

Consider the robustness of Proposition 2. First, the complementarity of l and z in production is a key property. However, this assumption is seemingly plausible for the relationship between tenured labour and the set of all other variable production inputs. Second, an interior symmetric equilibrium in pure strategies exists for many parametric forms of the government's preferences, the divisions' preferences, and the production technology, but not for all parametric specifications. In particular, if x and y are perfect substitutes from the perspective of the government, then the government's willingness to shift budget to the division that committed to higher labour input is not moderated by the fact that this will also increase the share in total output produced by this division, and this may lead to extreme outcomes in which the equilibrium is in mixed strategies. These equilibria will still exhibit a tendency for commitment to too high a labour input, but in a stochastic sense. Third, the framework can be generalized to more than two divisions. If the number of divisions is large, this will also make extreme outcomes with mixed strategy equilibria and over-hiring in a stochastic sense more likely. The intuition for this property is as follows. If there are many divisions, the decision of one division to increase its labour commitment in period 1 will draw an even larger share of the overall period-2 budget to this division. The reason for this increased budget reaction is that reallocating

an additional 100 dollars to division i will not require 100 dollars to be taken away from one other division, but only $1/(n-1)$ dollars from each of the other divisions. The opportunity cost of a budget withdrawal from another division is convex in the size of this withdrawal. The withdrawal of a given amount from many other divisions therefore has a lower opportunity cost than the withdrawal of this amount from one single division. Fourth, suppose the current period 1 is short in comparison to period 2, or that labour that is employed in period 1 yields commitment not only in one, but in many future periods. In this case, the cost of hiring an inefficient composition of input factors in period 1 are similar, but the benefits of its strategic commitment value accrue in a longer future period, or in many future periods. Accordingly, the incentives to hire excessive labour today are reinforced if it yields commitment for many periods.

The constraint (3) is crucial for the result in proposition 2. If, for instance, this constraint does not apply, then, in the equilibrium, the chief bureaucrat in each respective division will simply maximize x_2 or y_2 in period 2, and will choose the optimal factor input mix for achieving this. The optimization problems in period 1 and period 2 become fully independent, and a choice of a large l_{i1} does not increase this division's period-2 budget, which, in turn, makes it suboptimal to deviate from the efficient input mix

in period 1 as well. This is summarized as a proposition.

Proposition 3 *Consider the continuation game without tenure, i.e., if the constraint (3) need not hold. If the government allocates B_1 symmetrically among the divisions, then the equilibrium is characterized by*

$$b_{i1} = b_{i2} = \frac{B}{2} \text{ and } l_{i1} = l_{i2} = \lambda(\frac{B}{2}).$$

The outcome of the budget competition also depends on the relative size of the total budget today versus the size of the budget tomorrow. This effect is not directly visible from comparing the outcomes in propositions 1 and 2, as, in proposition 2, it was assumed that the budget size does not change over time.

We will now show that the strategic incentive vanishes in a situation with a sufficiently strong budget increase.

Proposition 4 *Suppose $\lambda\left(\frac{B_2}{2}\right) > \frac{B_1}{2} = b_{i1}$. Then,*

$$l_{i1} = \lambda(\frac{B_1}{2}), b_{i2} = \frac{B_2}{2}, \text{ and } l_{i2} = \lambda(\frac{B_2}{2})$$

are equilibrium values of choices in a symmetric, subgame perfect pure strategy equilibrium.

Proof. Note that $l_{i1} \leq b_{i1}$. Since $\lambda(\frac{B_2}{2}) > b_{i1}$, if the government chooses $b_{i2} = \frac{B_2}{2}$, the constraint (3) is never binding in period 2, regardless of the

choice of $l_{i1} \in [0, b_{i1}]$. The division bureaucrats will choose $l_{i2} = \lambda(\frac{B_2}{2})$ and $z_{i2} = \frac{B_2}{2} - \lambda(\frac{B_2}{2})$, and this maximizes G_2 for this given period-2 budget. Accordingly, by choosing $b_{i2} = \frac{B_2}{2}$, the government can implement efficiency in period 2, regardless of $l_{i1} \in [0, b_{i1}]$, and it is optimal to do so. Since bureaucrats cannot affect the allocation in period 2 by l_{i1}, they maximize x_1 and y_1 respectively. To do so, they choose the efficient labour input $l_{i1} = \lambda(\frac{B_1}{2})$. ■

For a division's efficient labour input tomorrow to exceed its budget today, i.e., $\lambda\left(\frac{B_2}{2}\right) > b_{i1}$, a strong expansion of the budget may be required, but sufficient budget growth eliminates the strategic impact of some production decisions in earlier periods, even if they yield long-term commitment to some factor inputs. In comparison to the results in proposition 2, this illustrates that growth of the bureaucracy is important for the efficiency of the bureaucrats' decisions. Furthermore, the result in proposition 4 provides a hypothesis about the labour intensity in the public sector as a function of expected changes in the overall budget. This hypothesis is specific to our theory and provides a potentially testable implication of our theory that distinguishes the strategic overhiring motive from other hiring motivations in the public sector.

Proposition 4 can be illustrated with the parametric example introduced above. Suppose $B_1 = 2$, and, hence, $b_{x1} = b_{y1} = 1$, and let $B_2 = 10$. Whatever the first period hiring decisions of the bureaucrats are, $l_{i1} \leq b_{i1} = 1$ for $i = x, y$. In the second period, the government will distribute B_2 such that this distribution maximizes G_2. It will, hence, share this budget equally between the two bureaus, as this will induce $l_{x2} = l_{y2} = B_2/4 = 2.5$, regardless of the previous choice of $l_{i1} \leq 1$, and will maximize G_2. Put differently, if the maximum amount of labour hired in the first period is smaller than what is the unconstrained optimal amount of labour in the second period, then hiring in period 2 cannot impose any constraint on the second period, and cannot be used as a strategic instrument.

5 Discussion and conclusions

A key prediction of the strategic hiring incentives is the high labour intensity in sectors with high employment protection. Alternative theories may, however, lead to observationally equivalent predictions. The result of proposition 4 provides an implication of strategic hiring that is specific and not shared by other potential explanations: the overhiring will be pronounced in non-expansionary time periods, but not in periods in which the bureaucrats anticipate major budget increases. This prediction can be contrasted with

some alternative motivations driving public employment decisions. Consider political patronage and rent-seeking motivations, or, alternatively, public employment in a second-best world with distortionary taxation. For both these motivations, no clear cut hypothesis about differences between expected expansionary and non-expansionary time periods stands out. In summary, provided appropriate data were available, our approach could be tested empirically given its unique prediction.

Strategic hiring in the public sector triggered by high employment protection may also apply in a much broader sense. Consider the situation in which a sponsor's funding decision takes on a discrete nature, i.e., when the decision concerns closing down a division entirely or not. If it is difficult to reallocate labour efficiently across units, hiring tenured labour serves some sort of "division entrenchment". If the decision is to close one of two units, this can be seen as an extreme form of budget competition. Obviously, also in this case, hiring tenured labour has a strategic value for a bureaucrat interested in the survival of her division.

The results have policy conclusions for the optimal organization of the public sector. Given the inefficiency caused by strategic hiring, one should observe the formation of institutions that limit or control hiring decisions. Such institutions are indeed widespread in the public sector.[10] Restrictions

on hiring are often deeply embedded in budgetary laws and procedures. In Germany, for example, budgeting has to follow the principle of qualitative specificity (*qualitative Spezialität*), which maintains that budgets are not global, but must be spent according to the specific spending categories (Andel, 1983; Senf, 1977).[11] Such restrictions suffer from various problems. The organization structure in the public sector is more complex in practice than in a stylized two-level framework. Public sector bureaucracies are characterized by multi-level hierarchies. Restricting hiring decisions at a given level shifts the decision problem to the next higher level. But the higher level has similar incentives for the whole organization governed by this level. In fact, this explains why hiring restrictions only work imperfectly in practice even if they are formally in place. Consider the case in which the analytical two-level framework is extended by allowing for a second sponsor with two subalternate divisions and an additional top-level sponsor that allocates the budgets to the two sponsors. The mid-level sponsors themselves may now be more lenient than is optimal with respect to divisional demands for additional permanent labour because the sponsor herself competes with the other sponsor for budgets and aims at strategically increasing her budget at the other's expense. Thus, restricting hiring decisions at one level may only move the problem to the next level, which then has insufficient incentives to

enforce such regulations.[12]

Taking this argument to the limit leads to the conclusion that all budgets should be completely specified at the highest level of government bureaucracy to avoid the efficiency costs of strategic hiring. Of course, this implies that the public sector would entirely dispose of the informational benefits of decentralized decision-making. This points to a fundamental trade-off that has to be resolved in the organization of the public sector. Avoiding strategic hiring requires strict and specific budgetary rules and hiring controls. These provisions come at the cost of centralized decision-making, and these factors need to be weighed against one another. As a corollary, we can point out that a move towards more independent budgeting at lower levels of government and towards global budgets is more likely to increase efficiency if employment protection is lower and / or wages are more flexible.

The trade-off between the incentives for strategic hiring and the efficient use of information that is available only at the lower levels of bureaucracy is related to the analysis of formal and real authority in organizations as developed by Aghion and Tirole (1997) in a principal-agent framework. They contrast the benefits of delegation, which are given by agents' incentives to acquire information and to participate in selected projects, with the costs of delegation, which are given by the principal's loss of control over the choice

of projects. Our approach stresses that the costs of delegation not only arise from the conflict of interest between the principal and the agent, but that the latter can be reinforced by the strategic behaviour of the agents. In particular, if bureaucrats are competing for the allocation of budgets, tenure in the public sector allows them to resort to strategic hiring with substantial costs regarding production efficiency. Thus, the optimal allocation of decision rights and budgets within the public sector needs to take into account the benefits of delegation, its potential costs caused by misalignments of interests, the scope for strategic behaviour, and the effectiveness of restrictions at individual levels of the bureaucracy.

Summarizing, institutions, such as divisions in a government bureaucracy or departments in a university, that can hire persons on long-term or tenured positions may want to use such hiring as a tool that yields commitment power in future budget allocations. This leads to too much hiring in such strategic positions. This theory is in line with, and explains restrictions on, the autonomy of hiring decisions which are widespread in the public sector. It is also consistent with the empirical evidence on labour intensity in the public sector, the observed pattern of inter-governmental transfers in federations, as well as with survey evidence of professors at a major German university that shows that public sector decision makers are indeed aware

of the role of strategic hiring.

6 References

Aghion, P. and Tirole, J. (1997). 'Formal and real authority in organizations', *Journal of Political Economy*, vol. 105(1), pp. 1-29.

Alesina, A., Baqir, R. and Easterly, W. (2000). 'Redistributive public employment', *Journal of Urban Economics*, vol. 48(2), pp. 219-241.

Andel, N. (1983). *Finanzwissenschaft*, Tübingen: J.C.B. Mohr (Paul Siebeck).

Bagnoli, M. and McKee, M. (1991). 'Controlling the game: political sponsors and bureaus', *Journal of Law, Economics and Organization*, vol. 7(2), pp. 229-247.

Carlsen, F. and Haugen, K. (1994). 'Markov perfect equilibrium in multi-period games between sponsor and bureau', *Public Choice*, vol. 79(3-4), pp. 257-280.

Chan, K. S. and Mestelman, S. (1988). 'Institutions, efficiency and the strategic behavior of sponsors and bureaus', *Journal of Public Economics*, vol. 37(1), pp. 91-102.

Clark, A. and Postel-Vinay, F. (2005). *Job security and job protection*, unpublished manuscript, DELTA/PSE.

Crain, W. M. and Oakley, L. K. (1995). 'The politics of infrastructure', *Journal of Law and Economics*, vol. 38(1), pp. 1-17.

Dewenter, K. L. and Malatesta, P. H. (2001). 'State-owned and privately owned firms: an empirical analysis of profitability, leverage, and labor intensity', *American Economic Review*, vol. 91(1), pp. 320-334.

Feld, L. P. and Schaltegger, C. A. (2005). 'Voters as a hard budget constraint: On the determination of intergovernmental grants', *Public Choice*, vol. 123(1-2), pp. 147-169.

Gelb, A., Knight, J. B. and Sabot, R. H. (1991). 'Public sector employment, rent-seeking and economic growth', ECONOMIC JOURNAL, vol. 101(408), pp. 1186-1199.

Gimpelson, V. and Treisman, D. (2002). 'Fiscal games and public employment: A theory with evidence from Russia', *World Politics*, vol. 54(2), pp. 145-183.

Glazer, A. (1989). 'Politics and the choice of durability', *American Economic Review*, vol. 79(5), pp. 1207-1213.

Gordon, R. H. (2003). 'Taxes and privatization', in (S. Cnossen and H.-W. Sinn, eds.), *Public finance and public policy in the new century*, pp. 185-211, Cambridge: MIT Press.

Grossman, P. J. (1994). 'A political theory of intergovernmental grants',

Public Choice, vol. 78(3-4), pp. 295-303.

Heymann, D. B. (1988). *Input controls in the public sector: What does economic theory offer?*, IMF working paper, WP/88/59.

Kraan, D.-J. (1996). *Budgetary decisions, a public choice approach*, Cambridge: Cambridge University Press.

Lopez-de-Silanes, F., Shleifer, A. and Vishny, R. W. (1997). 'Privatization in the United States', *RAND Journal of Economics*, vol. 28(3), pp. 447-471.

Moene, K. O. (1986). 'Types of bureaucratic interaction', *Journal of Public Economics*, vol. 29(3), pp. 333-345.

Niskanen, W. (1971). *Bureauracy and representative government*, Chicago: Aldine Publishing Company.

Perssson, T. and Svensson, L. E. O. (1989). 'Why a stubborn conservative would run a deficit: Policy with time-inconsistent preferences', *Quarterly Journal of Economics*, vol. 104(2), pp. 325-345.

Poutvaara, P. and Wagener, A. (2004). *Why is the public sector more labor-intensive? A distortionary tax argument*, mimeo., University of Copenhagen.

Rodrik, D. (2000). 'What drives employment in developing countries?', *Review of Development Economics*, vol. 4(3), pp. 229-243.

Senf, P. (1977). 'Kurzfristige Haushaltsplanung', in (F. Neumark, N. Andel and H. Haller, Hrsg.), *Handbuch der Finanzwissenschaften*, pp. 371-417, 3rd edition, Tübingen: J.C.B. Mohr (Paul Siebeck).

Footnotes:

1. This observation is documented in the findings of Clark and Postel-Vinay (2005), who analyse and document perceived job security empirically. Using data from the European Community Household Panel from 12 European countries, they find that, "...after controlling for selection, workers feel most secure in permanent public jobs." (p. 3) They also find that perceived job security of public sector jobs is, contrary to private sector jobs, not correlated with labor market institutions that provide insurance to workers, which leads them to conclude that "public sector jobs are by and large perceived to be insulated from labor market fluctuations." (p. 3)

2. For the US, Grossman (1994) finds that a one percentage point increase in the number of public employees per capita in a state increases the per capita grants received between US$ 65 and US$ 131. For Switzerland, Feld and Schaltegger (2005) estimate that the number of employees employed in the public administration at the Cantonal level increases grant transfers from the central government, with an estimated elasticity of 0.6.

3. High labor intensity in the public sector should be regarded as a

multi-causal phenomenon in practice. It has also been attributed to political patronage and rent-seeking, Gelb et al. (1991), Lopez de Silanes et al. (1997), and Alesina et al. (2000), or, alternatively, to second best arguments, Gordon (2003), Poutvaara and Wagener (2004), and Rodrik (2000).

4. We distributed 506 questionnaires to the professors' departmental addresses, and we received 238 replies (47%). The questionnaire and the dataset of the results can be found on the webpage http://www.wz-berlin.de/mp/mps/research/survey-results.en.htm.

5. Respondents could check "completely agree", "somewhat agree", "somewhat disagree", and "completely disagree", or "Don't know". The given numbers aggregate the two agree or disagree categories, respectively. For example, the 81.9% consist of 39.9% that checked "completely agree" and the 42% that checked "somewhat agree".

6. The correlation between the answers to questions about the departments resources (question 7) and the number of tenured professors in the department (question 8) as measured by Kruskal's γ is equal to -0.68, and as measured by Kendall's τ_b, -0.43, and the hypothesis that the latter is equal to 0 can be rejected at the 1% level. The relationship between the answers to questions about the non-tenured researchers (question 10) and the number of tenured professors in the department (question 8) as measured

by Kruskal's γ is equal to -0.19, and as measured by Kendall's τ_b -0.12, and the hypothesis that the latter is equal to 0 can be rejected at the 5% level.

7. The correlation between the answers to questions about the resources per professor (question 10) and the number of tenured professorships in the department (question 8) as measured by Kruskal's γ is equal to -0.03, and as measured by Kendall's τ_b, -0.02, and the hypothesis that the latter is equal to 0 cannot be rejected with a p-value of 0.76.

8. This is an equilibrium selection assumption that is important as it avoids a number of inefficient equilibria in which the divisions very much overinvest, anticipating that $G = 0$, but that the government will allocate the major share to one bureau in order to generate at least some positive output in x or y.

9. A similar strategic effect emerges in a context with one government and one bureaucrat, however, if the government budget is endogenous, and the government has increasing marginal cost of higher public expenditure. In this case, a single bureaucrat would also strategically overhire labor in the first period and induce a higher budget in period 2. The equilibrium can also be characterized by inefficiently high labor intensity in this case.

10. Heymann (1988) provides evidence that some higher level controls on hiring decisions exist in the public sector of all OECD countries.

11. A similar argument can be made for bureaucratic rules that prespecify the input mix ratio. If this ratio is fixed, this provides a commitment mechanism for the sponsor not to finance complementary inputs ex post.

12. The relevance of this problem can also be inferred from the survey results we presented in the introduction. The departments in a German public university also get specified budgets, and therefore have no formal authority to hire freely tenured labor. In reality, however, they have some discretion and can influence the hiring decisions, given their information advantage and their influence on the budgeting process. This is reflected in the responses of the professors reported in figure 1. 81.9% (85.9%) agree that their department can influence the hiring decision.

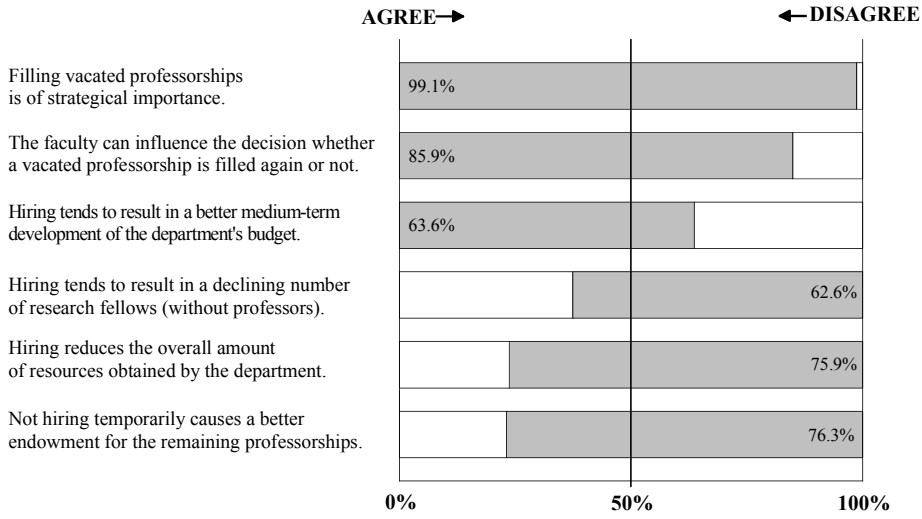

Fig. 1: Survey results on strategic hiring from the University of Hamburg without invalid and "Don't know" answers.