Sources of Cost Expansion: Primary Education in Norway 1946–1990

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ABSTRACT *Primary school spending growth is a concern in the public debate in Norway. During the 1980s, real spending per student increased by 35%, but no improvement in student performance has been documented. School spending is decided in a complicated process involving central and local governments and bargaining with teacher unions. In this econometric study the primary school spending growth is shown to be the result of cost factors determined at the national level together with lack of adjustment to rising costs in local governments. Policies to control school spending must address the bargaining strength of the central government to hold back on teacher wages and teacher employment and the responsiveness of local governments to higher costs.*

Introduction

The recent rise in primary school costs has received attention in the public debate in Norway. Spending per student has increased by about 35% in real terms during the 1980s, reaching about NOK 35 000 (£3200 or US$5500) on average in 1990. During 1980–1990, the employment of teachers continued to grow, from about 40 000 to 45 000 man-years, even when the number of students fell by 20%, from about 500 000 to 400 000. In some municipalities, average spending per student is above NOK 100 000 (£9000) in 1990.

Local governments have been blamed for the rise in spending. They are responsible for the national curriculum and the regulation of the primary school system. Local politicians have not been able to adjust the school structure to the decline in enrolment, and they have ended up with small and expensive schools and classes. Teacher unions have been criticized for their pressure to reduce the teaching obligations of teachers—and the reduction in working hours of teachers is seen as a major cost factor during this period. Since the central government organizes the bargaining with the national teacher unions about pay-scales and working hours, local governments complain that the central government is responsible for driving up school costs. There is need for an analysis of how different agents add to costs through the determination of grants-in-aid, teacher wages and teaching hours, and school size in particular.

The controversy over rising school spending coincided with new international studies that convincingly show a weak relationship between resource use and

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student performance, as summarized by Hanushek *et al.* (1996). The international evidence is consistent with the general understanding among the public that our primary schools have not improved during this period. Needless to say, there is great concern about the growth in school spending in this situation.

Investigating the determination of primary school spending can give us information of broad interest regarding the cost problems of the welfare state. Primary schooling is one of the major welfare state services together with health care and care for the elderly. As is the case with most welfare state services, they are organized as the responsibility of the local government sector. It follows that their costs are the result of complicated decision-making processes involving central and local governments. Both levels have autonomous decision-making authority, but in a unitary state the central government holds the upper hand and the local public sector is controlled through grants and regulations. Public sector trade unions are influential both at the local and national levels. The unions often organize professions (teachers, nurses) that show strong interest in the details of service production. The local political system in addition must handle pressure groups that are encouraged by the free distribution of the publicly provided private goods.

In this study, decisions at both national and local levels are treated as endogenous, and the bargaining between teacher unions and central government is explicitly taken into account. The analysis allows us to identify how the different decision-makers involved affect primary school spending. First, a theoretical framework is presented to clarify our understanding of the decision-making process, including central government, a teacher union and a representative local government. The central government and the teacher union are assumed to play Cournot, while the central government is a Stackleberg leader of the local government. The primary school spending is decomposed, so that the various decisions can be related to specific cost elements. The econometric analysis of the post-World War II period estimates the determinants of the spending components, taking into account economic and political factors. A companion paper, Falch and Rattsø (1996), analyzes the broader trends of school spending during 1880–1990.

Primary School Spending 1946–1990

Primary education covers the first 9 years of schooling and is the responsibility of local governments under strict central government control. Children have started school at 7 years old since the late 1800s, but the length of the programme has gradually increased. Children had 7 years of comprehensive school education when World War II ended. The academically oriented students entered the lower secondary school after 7 years, and the local governments also provided 1 or 2 years of voluntary continuation school after the initial 7 years, often the beginning of a vocational training. Experiments with an integrated 9-year school system began in 1959 and this system was made compulsory by law in 1971.[1] It follows that this analysis covers a period of extension of primary school to cover all 7–16-year-olds.

School spending can be decomposed into price and quantity components, spending per student and number of students. The analysis is based on a further decomposition, separating between teacher and non-teacher expenditure, and by disaggregating teacher expenditure into unit cost of teachers, teacher input per class and class size:

$$\text{School expenditure} = \left(\frac{\text{Teacher expenditure}}{\text{Teachers}} \star \frac{\text{Teachers}}{\text{Classes}} \star \frac{\text{Classes}}{\text{Students}} + \frac{\text{Non-teacher expenditure}}{\text{Students}}\right) \star \text{Students}$$

The decomposition is introduced to relate different decision-makers to different parts of the school spending equation. Comparable decompositions are used in the cross-country analysis of Schultz (1988) and the historical investigation of Hanushek and Rivkin (1994).

Primary school spending in real terms has multiplied 10 times since 1946, an annual real growth of 5.3%, as shown in Table 1. Since the GDP growth has been 3.2% during this period, the primary school share of GDP has been steadily increasing. The raw data confirm the Wagner law, and Wagner (1883) himself discussed schooling as a key example of public sector spending growth. The dominant part of the growth of total school expenditure can be attributed to teacher expenditure. While teacher expenditure continued to grow after 1975, total non-teacher expenditure was approximately constant. This is in contrast to the evidence from the US. Hanushek and Rivkin (1994) report that 'other expenditure' becomes larger than instructional staff expenditure during the 1970s and 1980s. Presumably the definitions vary, but nevertheless the difference in development and relative size of non-teacher spending between the two countries is remarkable.

The time paths of three endogenous cost components of teacher spending are shown in Figures 1–3, and they have quite distinct patterns. Teacher real wages and teachers per class reflect the improvements in the working conditions of teachers, and they have had steady growth. Teacher real consumer wages (excluding social costs as pensions and payroll taxes) nearly doubled from 1955 to 1975, from 100 000 to 200 000 1990-NOK. The introduction of a national pay-scale common for all teachers explains some of the wage growth during the 1950s, when wages were raised significantly for low-paid teachers in the districts. The harmonization of teacher wages across the country, as for wages of other public sector employees, was an important part of welfare state equalization policy, probably overcompensating the periphery where the cost of living is lower. Teacher man-years per class have risen from about 0.7 after World War II to almost 2 in 1990,

Table 1. School spending growth 1946–1990 (1990-NOK)

Spending per student	1946	1955	1965	1975	1985	1990
Teacher expenditure per student	3 198	4 113	7 766	17 238	23 652	28 311
Non-teacher expenditure per student	1 801	2 592	5 389	5 396	7 066	6 643
Decomposition of total teacher expenditure growth	**1946–1965**		**1965–1980**	**1980–1990**		**1946–1990**
Price						
Teacher wage expenditure	48.2		64.7	27.3		53.7
Teacher–class ratio	31.2		29.2	200.0		37.8
Class size	−17.2		−0.4	81.8		−6.4
Quantity						
Student enrolment	37.8		6.5	−209.1		14.9
Sum	100.0		100.0	100.0		100.0

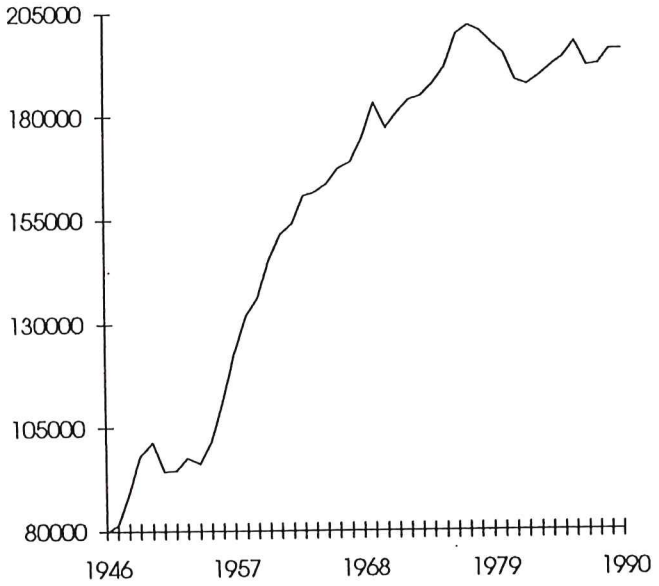

Figure 1. Teacher real consumer wage (1990-NOK).

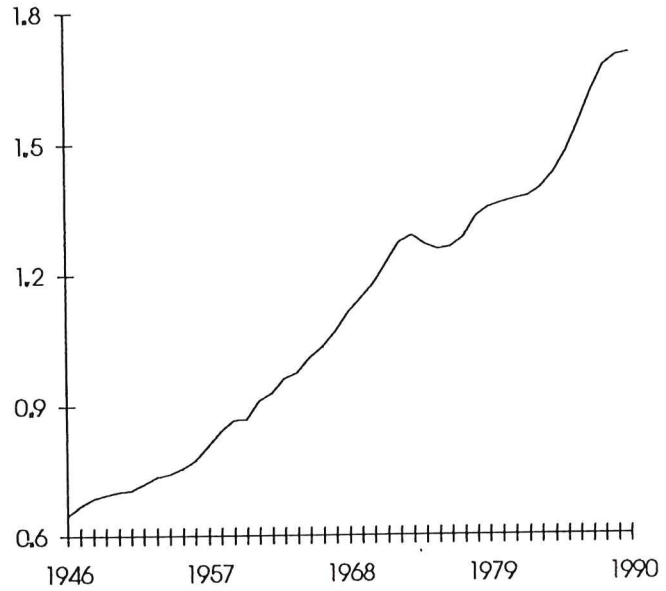

Figure 2. Teacher input per class.

first and foremost as a result of reduced teaching obligations for teachers. Comparing the two curves of Figures 1 and 2, it seems that teachers have to an increasing degree preferred to take their welfare out as reduced working time.

The third component, class size, looks like an inverted U, one big wave starting with about 16 students per class, rising to about 21 in the late 1960s, and contracting to about 19. Demographics have been an important background factor. The variables 'teachers per class' and 'class size' are drawn together to the teacher–student ratio in Figure 4. The rising costs of the 1980s are seen as the result of a combined increase in teachers per class and a fall in class size, a sharp rise in the teacher–student ratio. The development of the three components implies

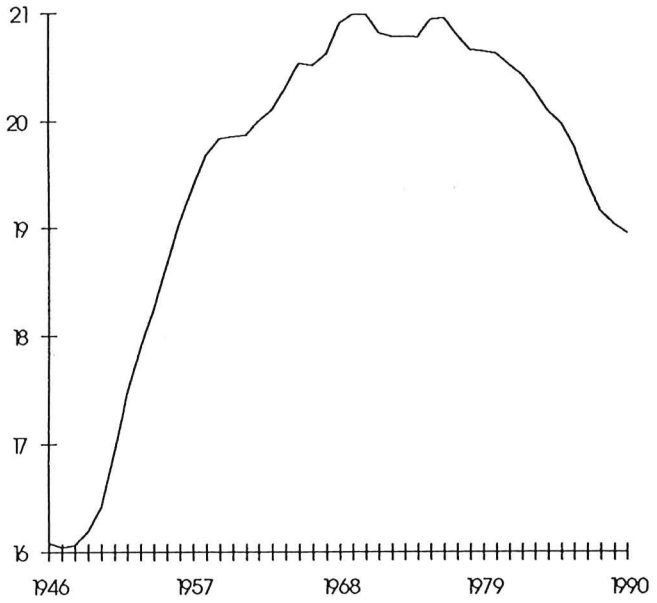

Figure 3. Class size.

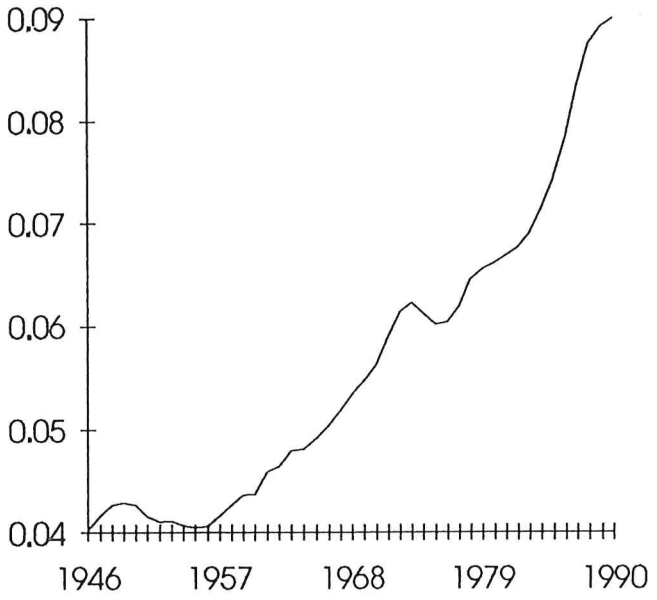

Figure 4. Teacher input per student.

that school spending per student is affected by distinctly different factors. As will come clear, different decision-making processes have also been involved.

Growth accounting of the components of teacher-related spending is reported in Table 1, while non-teacher spending is omitted due to lack of data. The percentage share of teacher spending increases is identified for each component. The post-war era is divided into three subperiods, defined by demographics and reforms. Primary education expanded with the baby boom into the mid-1960s. During the period 1965–1980, an integrated 9-year system was implemented and developed. Since 1980, primary schools have had to tackle a decline in student enrolment.

For the whole post-war period, teacher real wage and teachers per class account

for 90% of the rise in teacher spending. The rise in enrolment only contributes to about 15% of the costs, while a larger class size has helped to reduce school spending. However, the driving forces of spending growth have varied considerably over the three subperiods. The post-war baby boom shows up as a sharp rise in the number of students during the first period, accounting for close to 40% of the rise in spending. The baby boom was partly absorbed by larger classes, saving about 17% of the total spending. Teacher wage rises took about 50% of teacher-related spending increases, while more teachers per class represented about 30%. The period of consolidation of 1965–1980 implied only small rises in student enrolment and stable class sizes. All the rise in spending was related to teacher wages and teacher input per class.

The dramatic rise in the spending per student during the 1980s is clearly related to the drop in the number of students of about 20%. The average class size was allowed to be reduced. But teacher input per class, first and foremost related to teaching obligations of teachers, has been the major source of rising costs. Teachers reduced their working hours while teacher real wage growth stagnated. Presumably, this priority has been the policy of the teacher unions in a long-run attempt to improve their conditions.

Demographics is the underlying factor affecting student enrolment and class size. Interestingly, the two components tend to counterbalance each other's effects. The cost consequences of the baby boom during 1945–1965 was modified by rising class size. During the dramatic fall in students during the 1980s, class size decreased. Hanushek and Rivkin (1994) find the same development pattern of teacher–student ratio when the number of students fall in the US.

The Determination of School Spending

Since primary school is the responsibility of the local public sector in most countries, existing studies of resource use in schools concentrate on the local fiscal choice process. The determination of local school spending is formulated in the demand approach to public service production emphasizing local preferences and budget constraints. Inman (1979) and Rubinfeld (1987) represent comprehensive surveys. Local government behaviour is typically conditioned on natural decisions regarding grants, and cost factors such as teacher wages are taken as exogenous. Craig and Inman (1986) present the most comprehensive study of education spending, using a federalist framework emphasizing federal aid. Studies of Norwegian municipalities include Sørensen (1995), who has used our cost decomposition in a cross-sectional analysis of the variation in primary school spending. Borge and Rattsø (1995) have worked out a full demand system where all local public services including primary school are determined simultaneously.

There is a separate literature of labour-market studies investigating the determinants of teacher wages. Most American studies assume market-determined teacher wages, and bargaining is only accounted for by a union dummy. Eberts and Stone (1986) have estimated an efficient bargaining model of teacher wages and employment for the US, confirming the relevance of collective bargaining in this area. Dolton (1996) has shown the role of both market forces and bargaining mechanisms in several analyses of teacher wages in the UK. Labour market institutions are clearly of importance in understanding the remuneration and working conditions of teachers and thereby the cost of hiring them in the school sector.

In this study, we attempt to integrate the two types of analysis, combining the bargaining over teacher wages and working conditions and the local government priorities of schools. The decomposition model developed earlier identifies the four policy determinants of school spending analyzed here. Teacher wages and teacher input per class are assumed set in national bargaining between the central government and the teacher union. Class size and non-teacher spending per student are treated as local government decisions. It should be noted that the teacher–student ratio is separated into teacher input per class determined nationally and class size determined locally. This is clearly a stylized description, but we think it captures the key aspects of the decision-making situation. The influence of local versus central factors is tested in a separate section later.

The relationship between central government and local governments is inherently complex in school issues, since the division of labour and responsibilities is not all that clear. In fact, the teachers are employed by local governments, but their wages and working conditions are determined in bargaining with the central government. All in all, it is a very centralized system. The national welfare state defines rights to education to achieve equality across regions and income groups. Central government enforces this right through national laws and regulations, in particular a national curriculum. The Ministry of Education oversees the primary school sector and even has one representative in each country to ensure that laws and regulations are followed. As a result of the centralized control, central government is held responsible for the working of primary education in the public debate. Criticism of primary school quickly reaches the national press and the national politicians.

At the same time, local governments enjoy wide discretion in their local priorities for the school sector, as documented by the variation in spending between municipalities: spending per student ranges from NOK 25 000 to 100 000 (£2300–9000) and spending per class varies from NOK 500 000 to 1.1 million (£45 000–100 000) in 1990. Since the budget constraint of local governments is set by central government, they basically divide a given pie to various services. Local politics produces very different solutions to primary schooling, primarily in the form of school structure and thereby school and class size, but also in terms of non-teacher spending.

Both central and local governments are political institutions, and only taking into account economic conditions is too narrow a perspective. The bargaining game at the national level is influenced by economic and political factors relevant for the preferences and bargaining strength of the central government. National politics may also influence how central government deals with the local public sector. At the national level, municipalities are understood as a pressure group for increased spending, and characteristics of the political structure can be important for the outcome of such pressure. The local politicians experience pressure groups related to school location and teacher welfare, and the structure of local politics matters too.

An emerging literature links political structure to economic outcomes. Prominent examples include the analyses of US fiscal policy by Inman and Fitts (1990) and OECD budget deficits by Roubini and Sachs (1989). In the Norwegian context, Borge and Rattsø (1994) have documented the historical effects of political ideology and strength on the expansion of the local public sector 1880–1990. Kalseth and Rattsø (1995) have shown the influence of political strength in local government control of resource use in administration. In this study, both national and local politics are represented.

At the national political level, the post-war period has seen radically different conditions for the establishment of governments. Strøm and Leipart (1993) divide the experiences into three subperiods: social-democratic predominance (1945–1961); stable two-block competition (1962–1973); and polarization and fractionalization (1974–1990). Ideologically, we have seen the immediate rise of socialism after the war, and then a gradual decline. The strength of governments has also been on the decline, from the one-party majority situation (1948–1961) to various constellations of coalitions and minority governments. The influence of the shifting politics on the bargaining over teacher wages and employment is investigated. At the local level, ideological orientation has been potentially important for the priority of schooling versus other local services. Since interest groups operate in local politics, political strength is important at local government level as well.

Local Government Spending Decisions

Model

Local governments are assumed to influence school spending by determining class size and non-teacher spending per student. School expenditures compete with other local public services in the budget. Each local government operates under an exogenous budget constraint determined by income tax revenue sharing and grants. We follow the formulation suggested by Rattsø (1989), implying that Norwegian local governments basically divide a given pie between different services.

What do the local politicians take into account when they set the priorities of schools? It seems realistic that the local politicians do not know the relationship between school resource use and student achievement. No robust relationship has been revealed between resource input and student performance in schools. New and controversial studies (e.g. Card and Krueger, 1992) indicate that the teacher–student ratio and teacher pay may have a positive influence on student achievement. Hanushek *et al.* (1996) argue that the significant effects that are found can be attributed to aggregation bias. Even if teacher pay is of importance, local governments can hardly take much benefit from it since pay conditions are set in national bargaining. Presumably, local politicians have preferences for small classes and high non-teacher spending per student on broader political grounds.

Class size varies between municipalities and reflects school size and thereby school structure. Maximum class size has been reduced from above 30 to 27 students per class, restricting some local governments. However, the average class size is well below the maximum. The decentralized school structure chosen by most local governments reduces class size and is the key local decision taken regarding primary education.

To simplify the presentation, local governments are assumed to allocate resources to only two services, the other is called health. The utility function of the political leadership of the representative local government covers the inverse of the class size Cl/St (to simplify the handling of the budget constraint, Cl is the number of classes, St the number of students), non-teacher school spending per student Sp/St and per-capita health care output H. Sociodemographic characteristics of the municipality play a role in the background, influencing the local preferences. Since most of the services are directed towards specific age groups, the age composition of the population is relevant, and the settlement pattern may affect the location of the schools and thereby class size and non-teacher spending. The utility function is

$$V=V\left(\frac{Cl}{St},\frac{Sp}{St},H\right) \tag{1}$$

where V is assumed to be strictly quasi-concave.

The central government finances the local public sector services by a general grant (G is real and measured per capita) and a matching grant to schools (matching rate m). The budget constraint of local government says that the real value of the exogenous general grants covers the local government's share of total teacher wages and non-teacher school spending, taking into account the matching grant, in addition to spending on health care. Teacher man-years per capita are disaggregated to teacher input per class, T/Cl, inverse class size, Cl/St, and student share of the population, St/N, where T is the number of teachers and N is the population size. W_T is real producer wage of teachers. The budget constraint is[2]

$$G=(1-m)\left(W_T\frac{T}{Cl}\frac{Cl}{St}+\frac{Sp}{St}\right)\frac{St}{N}+H \tag{2}$$

Given teacher wages and teachers per class determined in the national negotiations, to be discussed, the local government maximizes (1) with respect to class size, non-teacher spending per student and health care output subject to (2). The solution of the decision problem implies demand functions for the three decisions variables, where we concentrate on the school sector:

$$\frac{Cl}{St}=\frac{Cl}{St}\left(\underset{-}{W_T\frac{T}{Cl}},\ \underset{-}{(1-m)\frac{St}{N}},\ \underset{+}{G}\right) \tag{3}$$

$$\frac{Sp}{St}=\frac{Sp}{St}\left(\underset{?}{W_T\frac{T}{Cl}},\ \underset{-}{(1-m)\frac{St}{N}},\ \underset{+}{G}\right) \tag{4}$$

Partial effects are indicated under each variable. The demand functions show how the centrally decided cost factors of educational services, the real producer wage W_T and teachers per class T/Cl, influence local government resource use in primary school. The demand curve for Cl/St is falling with respect to the two cost components under normal conditions, while the effect on Sp/St depends on whether the local decision variables of schools are gross substitutes or complements in demand. The budget constraint shows that the share of students in the population St/N is a cost factor in determining both class size and non-teacher spending, since primary school is compulsory for them all. Class size is reduced and non-teacher spending increased with higher revenues G when they are normal goods.

The demand functions are estimated using error correction models. Methodology and variable definitions are explained in the appendices. The socio-demographic characteristics included are the population size, the share of elderly, the divorce rate and the inverse relative size of agricultural employment as a measure of centralization.

Results

The demand model of local public finance is based on prices and income as major determinants. The estimation results reported in Table 2 show inelastic response

Table 2. Local government decision

Dependent variable	Class size	Non-teacher expenditure per student
Economic factors		
Local government income, LRE	—	1.00
School price, LRE	—	−1.00
Student share, LRE	0.43	—
Student share, SRE	0.45	−2.98
Spending share, SRE	—	−0.29
Sociodemographics		
Share of elderly, SRE	0.48	—
Divorce rate, LRE	−0.07	—
Centralization, LRE	0.14	—
Political economy		
Socialist share local parliaments, SRE	0.04	0.38
Social democratic hegemony, 1946–1961	−0.01	—

Notes: Only significant effects reported. The calculations are based on regressions 3a and 3b in Table B2. LRE is long-run elasticity and SRE is short-run elasticity. Elasticity at mean for political variables. School price is $W_T{}^*T/Cl$ and spending share is $(1-m)$.

to both income and cost factors. Local government choice of class size is independent of the income level. The absence of an income effect is surprising, since revenue shortage is a typical argument used when local politicians want to close small schools and thereby increase the average class size. Even though it cannot be rejected that non-teacher school spending has a long-run elasticity with respect to income equal to 1, schooling has the property of necessities at the local level.[3] Income-inelastic local government school spending is consistent with existing analyses of the Norwegian local public sector (Rattsø, 1989; Borge & Rattsø, 1995) and international studies as summarized by Inman (1979).

Important cost elements in primary education are exogenous to local government, primarily teacher wages and teaching obligations (teachers per class). Local governments do not respond very actively to the rise in these costs. Taking the two cost elements together to a centrally decided price of schooling, $W_T{}^*T/Cl$, non-teacher expenditure per student is reduced with higher costs, and the long-run elasticity is around unity. Class size and non-teacher spending seem to be gross complements. Class size is basically independent of the cost factors. The rigidity of class size confirms the general understanding that localization of schools is a key issue in local politics. There is not much trade-off with costs. The fact that primary school is inelastic with respect to centrally decided costs clearly contributes to spending growth. Matching grants also have no effect on class size, but our data on matching grants have not been complete.

The student share of the population enters the local government budget constraint in a similar way to teacher wages and teaching obligations. A higher student share increases the per-capita spending necessary to arrange a given primary education. The demand model predicts that a higher share of students in the population increases class size and reduces non-teacher spending per student. The estimates suggest that student share is a major determinant of class size and, in the short run, non-teacher spending per student is also reduced with higher

student share. Class size adjusts when the enrolment of students varies with demographic changes.

Except for the economic factors, local priorities are influenced by sociodemographics and ideology. When the share of the elderly goes up, class size is increased. The result confirms the negative relationship between share of the elderly and school spending share of total local budgets as investigated in more general allocation models in Norway (Rattsø, 1989). A variety of sociodemographic descriptives has been investigated. A social characteristic, the ratio of divorces to marriages, reduces the class size in the long run. The effect possibly reflects a compensating strategy from the local governments: social problems among the young are handled by putting more resources into schools. Centralization is also important for the adjustment of class size. Higher population density is associated with increased class size.

Studies of local governments investigating aggregated spending measures tend to conclude that local politics is of no importance. When school spending is decomposed, the importance of socialist influence in local councils is detected. A higher socialist share of representatives tends to increase non-teacher spending per student, but at the same time class size is increased. The socialists have preferences for large schools, thereby allowing them more funds for non-teacher spending.

The role of local governments in explaining the school spending growth is in non-adjustment. Even when the school costs go up dramatically, local governments are not willing to increase class size. According to our results, local governments allowed class size to decline by 10% when the number of students fell by 20% during the 1980s. The rising share of the elderly has helped to hold down school spending, since this has stimulated reallocation of resources to care for the elderly.

National Bargaining of Teacher Labour Contracts

Model

The national agreement between the government and the teachers set labour-market determinants of school spending: teacher wages and teacher working hours, and teaching requirements. As explained earlier, the teacher–student ratio is disaggregated: the national bargaining concerns part of the employment decision, teachers per class, while local governments decide another part, class size. The bargaining models of Inman (1981) over wages, employment and pension funding in the public sector cover both approaches dominating the literature on trade unions: the 'right to manage' model and 'efficient bargains'. In the right to manage models, the union and the employer bargain over the wage level, while the employer sets the employment level afterwards. Inman shows that this is not an efficient solution when insiders and outsiders have the same weight in the union utility function. Efficient bargains imply simultaneous bargaining over both wage level and employment.

Our model is somewhere between these two approaches and involves a third participant, local governments. Bargaining over teachers per class can be seen as bargaining over hours of work, as analyzed by Earle and Pencavel (1990). An alternative interpretation is bargaining as a kind of featherbedding discussed in Johnson (1990), either as bargaining over work intensity or a situation where a fraction of the workforce has literally nothing to do.

The bargaining approach applied assumes the conventional asymmetric Nash

bargaining game. When x is the indirect utility function of the government and U the utility function of the teacher union, the Nash product is

$$\Pi=(x-X^0)^{\gamma}(U-U^0) \tag{5}$$

where γ is the relative bargaining strength of the government, and X^0 and U^0 are the threat points of the two. The threat points represent the utility levels during conflict.

Central government, in principle, takes into account all concerns of the nation, including the priorities of local governments. It seems fairly accurate to assume that central and local governments agree. Central government preferences consequently include the indirect utility function of the representative local government $v(\cdot)$.[4] It follows that the central government is a Stackelberg leader *vis-à-vis* the local government. In addition, central government evaluates other public consumption B and private consumption C per capita. Central government maximizes the strictly quasi-concave utility function $X=X(v(\cdot), B, C)$, taking into account the overall budget constraint of the economy given by $\text{GDP}=C+P\cdot B+P\cdot G$.[5] Real GDP measured in private goods (GDP) is allocated to private consumption, public goods and financing of local services, where P is the relative price of public consumption. The indirect utility function included in (5),

$$X=x\underset{- \quad - \quad - \quad +}{\left(W\frac{T}{Cl}, \frac{St}{N}, P, \text{GDP}\right)} \tag{6}$$

is defined by the central government decision problem.[6] W is real consumer wage (defined as $W_T\cdot P$). Three cost factors and an income variable enter the indirect utility function.

Our analysis addresses political ideology, which can be reflected in the form of the government utility function and influence the government threat point. The main ideological variable in the national parliament is the share of socialist representatives. We expect the socialists to give priority to primary schools because of their importance for equalization and solidarity between income groups.

The teacher union has preferences regarding wages and employment, and wage comparison effects influence the utility level. W_c is the wage level of the group that teachers compare themselves with. The per-capita teacher input is disaggregated to fit the demand outlined earlier:

$$U=U\underset{+ \quad + \quad -}{\left(W, \frac{T}{Cl}\frac{Cl}{St}\frac{St}{N}, W_c\right)} \tag{7}$$

where U is also assumed to be strictly quasi-concave.

The utility function of the union presumably is influenced by the sex composition of the teachers. Female teachers are expected to have higher preferences for short working time than males. The large increase in the number of female teachers during the 1980s may have changed the union policy towards more pressure for reduced working time and improvements of working conditions, at the cost of lower pressure for wage growth.

The threat points of the bargaining parties are important in the Nash bargaining game. They are influenced by the labour-market situation, institutional factors and the political environment. We have simply assumed that the government's threat

point depends on the reaction of the population during a conflict, related to the ideological climate. The government is based on electoral support, and its bargaining strategy will take public opinion into account. If socialists have preferences for schooling, a socialist-oriented opinion may be willing to accept more of the claims from the teacher union. The threat point of the union is influenced by the probability of getting another job, which is discussed further in the following.

Maximizing (5) with respect to teacher wages and teachers per class gives the bargaining solution. The reduced form equations follow as (8) and (9), where the partial effects of the exogenous variables on the two school cost factors are indicated:[7]

$$W = W\left(\frac{St}{N}, P, \text{GDP}, W_c, \gamma\right) \qquad (8)$$
$$\quad ? \quad - \quad + \quad + \quad -$$

$$\frac{T}{Cl} = \frac{T}{Cl}\left(\frac{St}{N}, P, \text{GDP}, W_c, \gamma\right) \qquad (9)$$
$$\quad - \quad - \quad + \quad ? \quad -$$

Both teacher wages and teacher input per class are stimulated by a rise in GDP, an improvement of the overall budget constraint, because central government utility is increased. A higher share of students in the population, *St/N*, will increase teacher employment, which in part causes the union to push harder for wages at the expense of employment. This can be interpreted as a demand effect. But at the same time, the student share acts as a cost factor in the government budget constraint, reducing government utility. The effect on wages of *St/N* is therefore uncertain. Teacher input *T/Cl* is definitely reduced. Increased relative price of public services, *P*, reduces central government utility level, while the comparison wage only influences the union. When the comparison wage goes up, the union prefers higher wages relative to employment. The teacher wages will go up, while the effect on teacher input *T/Cl* is uncertain because at the same time the union utility is reduced.

Bargaining Strength

In the Norwegian political system, the party composition of the parliament and the parliamentary basis of the government determine the political control. First, dummy variables are constructed to represent two dimensions of the government, majority/minority and coalition/non-coalition, inspired by Roubini and Sachs (1989) and Edin and Ohlsson (1991). Second, long survival of the government also reflects strength, and the duration of the government is included. Third, to investigate the role of the parliament, a Herfindahl index is constructed to represent party fragmentation. A multi-party parliamentary system is more likely to produce a strong government the less fragmented the party composition of the parliament. And fourth, the effect of real local public debt per capita is investigated. We expect that central government is able to use the debt situation of local governments as an argument in the negotiations, thereby increasing bargaining power.

In addition, the macro-economic situation can influence the bargaining. Svejnar (1986) and McDonald and Suen (1992) find that the relative bargaining power of

the unions in the private sector decreases with unemployment. With unfavourable economic conditions, moderation can be seen as important to contribute to improving the state of the economy. The employer's position relative to the union is strengthened. But the role of the government is more complicated than that of a firm in private markets. Public expenditure may be used as a counter-cyclical stabilization policy. If the government increases public employment during economic decline, the union is expected to push harder for wage increases. The standard prediction of the role of the labour-market conditions consequently may go wrong.

Unemployment can also influence the union threat point via the probability of getting another job. Both general unemployment and the labour-market situation for teachers can be important. The 1950s and 1960s were characterized by excess demand for teachers, with up to 20% of the employed teachers without formal teaching qualifications. This group was employed on short-term contracts, and they can serve as a proxy for vacancies. Dolton (1996) shows the same development for Britain. We expect the vacancy rate to increase wages both via union pressure and political reaction to excess demand.

Results

Economic models of public sector growth are based on price and income elasticities as driving forces. Wagner's (1883) law and Baumol's (1967) disease are the two main hypotheses built into the framework of Borcherding (1985). We cannot reject that the long-run income elasticities of teacher real wages and teacher input per class are both equal to 1. Taken together, they imply income-elastic primary school spending. The growth in GDP is the main factor behind the school spending growth, according to the results in Table 3.

It is hard statistically to distinguish between an income effect and a wage comparison effect on teacher wages. If GDP is replaced by manufacturing wages, they have a significant long-run elasticity of 0.7. But the model presented here clearly encompasses such a specification. Our results indicate that the income level of the society is important for long-run development of teacher wages, not the wages of other groups. The comparison wage does not even have a short-run effect.[8]

Baumol's disease says that public spending goes up with the price of public services when the demand is price-inelastic. Borcherding (1985) and others confirm the Baumol concern. In our model, the price of school services is endogenously determined by national bargaining. The relative price between private and public goods is the variable typically used when testing for price inelasticity in the public sector. We find no effect of this variable. The inelastic price effect can explain some of the school spending growth.

The theoretical model predicts that a higher share of students in the population reduces teacher input per class through the cost side of the budget constraint of the local government and through union considerations. But teachers per class is inelastic with respect to this cost factor. The relationship between student share and teacher real wages is best interpreted as a conventional labour demand relation, definitely in the long run. In the short run the government is able to use the cost effect of higher student share as an argument in the bargaining.

Labour-market conditions do affect school spending. As expected, the vacancy rate in primary schools has a positive long-run effect on wages. A higher share of

unqualified teachers, our measure of vacancy, improves the employment opportunities of qualified teachers, and they can push harder for wage rises. In addition, the government is expected to offer higher teacher wages to attract teachers from other occupations when the vacancy rate is high. Note that the direct effect of a higher share of unqualified teachers is to reduce the wage level since they are paid lower salaries. This direct effect may explain why there is no short-run effect.

It is interesting to compare the long-run elasticity of 0.09 with the wage curves estimated in Blanchflower and Oswald (1995). They find an elasticity of unemployment of approximately -0.1 in many countries, including the effect of industrial unemployment in the US. Taking vacancies as negative unemployment, we find the same effect of teacher unemployment in the Norwegian teacher labour market.

General unemployment has no effect on teacher wages. The reason may be opposite effects of counter-cyclical policy and the probability of finding alternative jobs in the private sector. It seems that real wage responsiveness to general unemployment is lower in the public sector than in the private sector, in accordance with results from the US (Blanchflower & Oswald, 1995, p. 159).

Among the preference variables introduced, the role of female teachers stands out. A higher share of female teachers increases teachers per class but reduces wages. Our interpretation is that union considerations are important. Female teachers push union aspirations away from wages and towards a shorter working day. The net effect on school spending is negligible. According to our results, the mean growth in the share of female teachers of 2.3% during the 1980s increased the annual growth in teacher input per class by 0.9% and reduced the annual growth of wages by 0.8%. Sociodemographic variables relevant for local decision-making do not affect central bargaining. Socialist inclinations in parliament are ineffective, except for the period of socialist dominance (1948–1961) when wages were significantly higher.

Bargaining strengths influence the bargaining outcome through various channels. The results reported in Table 3 imply that the working of the political system influences spending growth. Two of the measures of political strength are shown to be important: party fragmentation in the parliament influences both teacher wages and teacher input per class, while government duration influences teacher wages. The fragmentation of the parliament has a strong and highly significant effect on teacher input per class. Union arguments for higher teacher intensity are often related to school quality. This type of lobbying activity has more success when the parliament is fragmented. When the party fragmentation is increased with one standard deviation (that is 10%), teacher input per class is increased by almost 8% in the long run. Increased fragmentation contributed to almost half the growth in teacher input per class during the 1950s and 1960s.

The effect on teacher wages is a bit smaller. Wage adjustment follows more basic rules and is easier to observe. The cost consequences of wage increases are easier to measure, making the room for lobbying smaller. When party fragmentation is increased with one standard deviation, teacher wages are increased by 2% in the long run. In addition, a government of long standing is able to hold down wage growth. An experienced government has learned how to handle complex bargaining games. When a government's duration is doubled (that is 1.5 standard deviations), teacher input per class is reduced by 4% in the long run. The local government debt situation matters too. The results of this bargaining power variable and of political structure are encouraging for our broad understanding that

Table 3. Central government bargaining

Dependent variable	Teacher wages	Teachers per class
Economic factors		
GDP, LRE	1.00	1.00
Student share, LRE	0.44	—
Student share, SRE	−1.99	−0.38
Inflation	−0.66	
Union considerations		
Vacancy rate, LRE	0.09	—
Female share, SRE	−0.35	0.39
Ideology		
Social democratic hegemony, 1946–1961	0.02	—
Bargaining power		
Local government debt, LRE	−0.40	—
Government duration, LRE	−0.04	—
Party fragmentation, LRE	−0.22	−0.76

Notes: Only significant effects reported. The calculations are based on regressions 3a and 3b in Table B3. LRE is long-run elasticity and SRE is short-run elasticity. Elasticity at mean for political variables.

bargaining positions have a role to play in the understanding of the development of public sector spending.

Central or Local Decisions?

The division of labour between central and local governments is not as clear cut as outlined in our theoretical model. Central government tries to influence class size by rules for maximum class size and maximum travel distance to schools. On the other hand, local governments can have some influence on teacher wages by recruiting experienced teachers, promoting teachers into advisory positions and giving them administrative responsibilities. Teachers per class is realistically the result of both national bargaining over teacher working conditions and local priorities of teacher input, in particular related to handicapped students and low achievers. To check if our analysis captures the main local and central determinants of school spending growth, for each variable, we have tested whether a model with local or central explanatory variables performs best. We focus on the influence of income and politics. The encompassing tests are reported in Table 4.

Regarding teacher wages, we cannot reject the hypothesis that a model with national income level as determinant encompasses a model using the local income level, but the opposite hypothesis is rejected. The same result appears for teacher input per class, in accordance with our assumptions. Sørensen (1995) finds that some of the variation in teacher input per class between local governments can be explained with local explanatory variables. We agree that some local variation takes place, but our interpretation is that central decisions dominate the development over time. The ideological impact of socialist share of representatives is negligible, both when measured for national and local parliaments.

Turning to the two variables assumed to be determined at the local level, it seems like both local and national income influence non-teacher spending per student. Statistically GDP cannot be excluded from the equation determining

Table 4. National versus local decisions

Dependent variable	Local versus national income				Local versus national ideology			
	W	*T/Cl*	*St/Cl*	*Sp/St*	*W*	*T/Cl*	*St/Cl*	*Sp/St*
Sample period	1948–1990	1948–1990	1948–1990	1974–1990	1948–1990	1948–1990	1948–1990	1974–1990
Encomp(national)	0.548	0.756	0.926	0.012	0.601	0.479	0.135	0.240
Encomp(local)	0.003	0.002	0.354	0.098	0.893	0.756	0.677	0.301

Notes: Regressions 3a and 3b in Tables B2–B3 without restrictions augmented with GDP and *G* in the tests for local versus national income, and with the share of socialists in local and national parliaments in the tests for local versus national ideology. In both cases the variables are included at level and at differenced form. Encomp(national) is an *F*-test for excluding local variables, and vice versa for Encomp(local). *P*-values presented.

non-teacher spending at 10% level. Local political orientation, and not national politics, is important, in particular for class size. All in all, the interactions between central and local governments in practice implies that both levels have some influence over teachers per class and non-teacher spending.

Summary and Conclusions

We have shown how central government, teacher unions and local governments have influenced the remarkable primary school spending growth during the post-World-War II period. The three agents have different roles in the decision-making process, and they all contribute to the expansion of school resources. At the national level, teacher unions struggle for higher teacher wages and reduced teaching load. They have been successful, and these two elements are the main cost factors identified. Future analysis must judge whether teachers have been more successful than other government employees. The central government tries to hold back on the claims of the teacher union. The bargaining strength of central government, both in terms of macro-economic situation and political structure, is shown to matter.

Interestingly, education come out as an income-elastic good in the present study. The income elasticity of primary school spending is above 1.5,[9] implying strong support for Wagner's law. Education is an area cited by Wagner where he saw collective producers as more efficient than private ones. Our analysis suggests a solution to the puzzle that time-series analyses show income-elastic school spending, while cross-sectional analyses offer overwhelming evidence of income-inelastic educational services (see the overview of Inman, 1979). There is limited variation of teacher wages and teacher input per class across municipalities. Spending growth is driven by income-elastic decisions about teacher wages and working conditions at the national level.

Clearly, central government does not work primarily as an institution resisting school spending. Rather the other way around. All major primary school reforms during the period studied, in particular the 9-year compulsory school, were instigated by central government. It is seen too that local governments implement the reforms by channelling more resources to the local public sector. Local governments have been a source of school spending growth by non-adjustment to centrally determined cost factors—teacher wages and teaching load. The inelastic response to rising costs means that national cost expansion is translated directly to higher spending. The non-adjustment has been most pronounced regarding the demographic shifts. The declining share of students in the population during the 1980s has increased spending, since class size has been allowed to go down, thereby contributing to the dramatic rise in teacher–student ratio and per-student spending.

The good news is that political factors can control school spending growth. Strong central governments can hold back teacher wages and maintain teachers' teaching loads. Efficient local governments can adjust the school structure to demographic changes and try to substitute away from ever-more expensive teachers.

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Notes

1. The enrolment ratio for the age group 7–16 increased from 90% in 1946 to 97.5% in 1960 and 100% since 1971. It follows that the number of students partly increased due to a higher enrolment ratio before 1971.
2. Matching grants to health care are excluded from the analysis and the model because data have not been available.
3. The elasticity of total school spending (SS) is calculated as

   $$El_{SS} \approx \lambda(El_W + El_{T/Cl} - El_{St/Cl}) + (1-\lambda)El_{Sp/St}$$

   where El is a symbol of elasticity and λ is the teacher spending share of total spending. λ is calculated at post-1973 mean, where $\lambda = 0.78$. At the local level $El_W = El_{T/Cl} = 0$, and the income elasticity of total school spending is about 0.2.
4. The local government demand functions related to primary school (equations (3) and (4)) and health care inserted into (1) define the indirect utility function of the local government:

   $$V = v\left(\underset{-}{W_T}\frac{\underset{-}{T}}{Cl}, \frac{\underset{-}{St}}{N}, \underset{+}{G}\right)$$

   where m is excluded from the model.
5. Matching grants have been excluded in this section. Our simplification of the decision-making situation has produced a problem: matching grants have no role in a model with one representative local government and where local and central preferences agree.
6. The outcome of the bargaining game between the central government and the teacher union depends on the effects of exogenous variables on the utility levels. We therefore use the indirect utility function of the central government. The demand functions for the public good B, the private good C and grants G are derived by maximizing the central government utility function X subject to the budget constraint and the local government indirect utility function. Together with the national government utility function, they define the indirect utility function of the national government.
7. A formal analysis of the model, and a discussion of the partial effects, is available from the authors.
8. In order to test for other comparison wages than manufacturing wages, we tested the effects of average wage measures from the national accounts, only available from 1962. It seems like teacher wages follow both the wage level of central government employees and GDP with an elasticity of 0.5 in this period, while it is a clear short-run effect of wages in private services. More thorough investigation of wage comparison effects is necessary before drawing definite conclusions.
9. This elasticity is calculated in accordance with Note 3. The precise elasticity depends on the effect of GDP upon local government income. Borge and Rattsø (1994) calculate this to be 1.4, implying an income elasticity of total school spending of 1.9.

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Appendix A: Data

Data sources are available on request.

W	Real consumer wage, yearly nominal wage for teachers deflated with the consumer price index. Before 1958, W is calculated as total teacher wage cost per teacher man-year. From 1959, W is calculated as mean gross paid wage. Data are not available, and nominal wage is interpolated, during 1958, 1960–1962, 1964–1966 and 1968–1972.
W_T	Defined as W/P.
P	Price index for public consumption divided with the consumer price index.
T	Number of teacher man-years. T is calculated as the number of teachers in full post plus the half of the teachers reported in part time post. The definition of part-time post was changed in 1973.
Cl	Number of classes.
St	Number of students.
N	Population.
m	Matching grant rate. Calculated as total earmarked grants in relation to total school spending in the equation for non-teacher spending per student. Because total school spending is not available for 1958–1972, m is calculated as total earmarked grants in relation to $W_T{}^*T$ in the class size equation.
GDP	Gross domestic product per capita deflated with the consumer price index.
G	Municipal and county spending per capita deflated with the price index of public consumption. G includes both consumption and investment expenditures. Interest payment and downpayments on loans are excluded.
infl	Yearly percentage change in the consumer price index.
ELDERLY	Share of population above age 65.
DIV	Share of divorces to total marriages.
CENT	Inverse of the share of total man-years in agriculture.
W_c	Yearly wage rate in manufacturing deflated by consumer price index.
UNEM	Average unemployment ratio.
VAC	The vacancy rate in primary school, measured as the share of teachers in full post without teacher training course. These teachers are employed on short-term contracts.
FEMALE	The share of female teachers among teachers in full post.
DEBT	Municipal and county total debt per capita deflated with the price index of public consumption.
SDM	Dummy variable for the majority government of the social democratic party, 1946–1961.
TBC	Dummy variable for the period with stable two-block competition, 1962–1973.
SOCN	Share of socialist representatives in the national parliament. Representatives from the Labour Party, Communist Party and Socialist Left Party are treated as socialists.
SOCL	Share of votes on socialist parties in local elections.
COAL1	Coalition government in minority.
COAL2	One-party government in minority.
COAL3	Coalition government in majority.
DURN	Duration of the national government in years.
HERFN	Herfindahl index for party fragmentation of the national parliament, calculated as

$$\text{HERF} = \sum_{p=1}^{P} SH_p^2 \qquad \text{(A1)}$$

where SH_p is the share of the seats held by party p.

HERFL	Herfindahl index for party fragmentation of local councils, calculated as (A1), but SH_p is the share of votes in local elections.
FREEZE	Income policy dummy due to wage freeze. FREEZE = 1 in 1979 and 1988, 0.5 in 1989 and 0 otherwise.
D58, D7390	Dummy variables for 1958 and 1973–1990 respectively.

Appendix B: Econometric Method

Table B1 outlines unit root tests for the time-series properties of all variables in the model. The variables are defined in Appendix A. Population share variables (ELDERLY and *St/N*) have a time development like big waves, as class size, which implies that the growth rates also move like big waves. These variables are consequently modelled in a more flexible form than the other variables. All other variables seem to be integrated of order one, $I(1)$; they grow over time, but the changes in the variables fluctuate around an 'equilibrium'.

The econometric formulations assume error-correction models. The following procedure is applied. First, a general economic model, with no political variables, is reduced to a model with only significant effects at 10% level. Since the development over time in the endogenous variables is so different, there is no reason to think that they are determined by the same factors. Second, the effects of political variables measuring ideology and political strength are tested. Because of some political sluggishness, we concentrate on one lag in these variables. The full political economy model is then reduced to a preferred model.

The general class size equation (excluding political variables) is

$$\begin{aligned}\Delta(st-cl)_t = {} & \xi+\eta_0(st-cl)_{t-1}+\eta_1(st-cl)_{t-2}+\eta_2 g_{t-1}+\eta_3(w_T-(t-cl))_{t-1}\\ & +\eta_4\log(1-m)_{t-1}+\eta_5(st-n)_{t-1}+\eta_6 n_{t-1}+\eta_7\text{elderly}_{t-1}+\eta_8\text{div}_{t-1}\\ & +\eta_9\text{cent}_{t-1}+\alpha_1\Delta g_t+\alpha_2\Delta(w_T-(t-cl))_t+\alpha_3\Delta\log(1-m)_t\\ & +\sum_{i=0}^{1}(\alpha_{4i}\Delta(st-n)_{t-i}+\alpha_{5i}\Delta n_{t-i}+\alpha_{6i}\Delta\text{elderly}_{t-i})+\alpha_7\Delta\text{div}_t+\alpha_8\Delta\text{cent}_t+\varepsilon_{1t}\end{aligned} \tag{B1}$$

where ε_{1t} is a stochastic error term, Δ is a differential operator and lower-case letters denote logarithmic form. See Appendix A for definitions of variable symbols. We allow for different effects of student share *St/N* and spending share (1-*m*) because it is difficult to measure the marginal effects of matching grants, see also Appendix A. The coefficients α_1 through α_8 express short-run elasticities, while $-\eta_2/(\eta_0+\eta_1)$ through $\eta_9/(\eta_0+\eta_1)$ can be interpreted as long-run elasticities.

Data for non-teacher spending per student only covers the period 1973–1990. This model is therefore more restricted. Compared to equation (B1), the following variables are excluded from the general model of non-teacher spending per student: the dependent variables lagged twice, all lagged differenced variables, *n*, Δn, cent and Δcent.

Table B1. Unit root tests

	Mean	$I(1)$	$I(2)$	$I(3)$		Mean	$I(1)$	$I(2)$
$(st-cl)$	19.53	−3.50	−1.60	−7.40	div	0.15	0.60	−4.25
$(sp-st)$"	5 838	−1.57	−3.77	—	cent	0.11	−0.30	−3.37
$(t-cl)$	1.07	−0.79	−4.06	—	w_c	122 311	−1.44	−5.49
w	151 399	−1.73	−4.33	—	unem	1.22	−0.29	−6.17
gdp	89 275	−1.24	−5.60	—	vac	0.09	−0.44	−3.28
g	12 860	0.37	−6.61	—	female	0.46	−2.27	−3.43
$(w_T+(t-cl))$	166 887	−1.42	−5.01	—	debt	10 111	0.08	−5.39
$\log(1-m)$	0.34	−1.28	−7.23	—	SOCN	0.51	−2.18	−6.28
$(st-n)$	0.14	−0.90	−2.72	−4.04	DURN	11.25	−1.11	−6.39
p	0.97	−1.47	−6.09	—	HERFN	0.31	−1.43	−5.75
elderly	0.12	−2.63	−1.17	−6.77	SOCL	0.47	−1.05	−6.16
n	3 769 000	−2.50	−2.21	−4.96	HERFL	0.24	−1.92	−6.08
infl	0.06	−3.78	—					

Notes: Augmented Dickey–Fuller tests, where the last lag is skipped until it is significant at 5% level. Sample period is 1951–1990, critical value at 5% level is −2.92. $I(1)$, $I(2)$ and $I(3)$ indicate null hypothesis. Mean values in 1990-NOK for full period are not logarithmic form. "Sample period is 1976–1990.

The models regarding centrally determined teacher wages and teacher input per class look very similar to equation (B1). The general model for teacher wages is

$$\begin{aligned}\Delta w_t = {} & \xi_t + \mu_0 w_{t-1} + \mu_1 \text{gdp}_{t-1} + \mu_2 (st-n)_{t-1} + \mu_3 p_{t-1} + \mu_4 n_{t-1} + \mu_5 \text{elderly}_{t-1} + \mu_6 \text{div}_{t-1} \\ & + \mu_7 \text{cent}_{t-1} + \mu_8 w_{c,t-1} + \mu_9 \text{unem}_{t-1} + \mu_{10} \text{vac}_{t-1} + \mu_{11} \text{female}_{t-1} + \mu_{12} \text{debt}_{t-1} \\ & + \beta_1 \Delta \text{gdp}_t + \beta_2 \Delta p_t + \beta_3 \text{infl}_t + \sum_{i=0}^{1} (\beta_{4i} \Delta (st-n)_{t-i} + \beta_{5i} \Delta n_{t-i} + \beta_{6i} \Delta \text{elderly}_{t-i}) \\ & + \beta_7 \Delta \text{div}_t + \beta_8 \Delta \text{cent}_t + \beta_9 \Delta w_{c,t} + \beta_{10} \Delta \text{unem}_t + \beta_{11} \Delta \text{vac}_{t-1} + \beta_{12} \Delta \text{female}_{t-1} \\ & + \beta_{13} \Delta \text{debt}_{t-1} + \varepsilon_{2t}\end{aligned} \tag{B2}$$

where the vector ξ_t represents both a constant, a dummy variable for 1959–1990 at level and at differenced form because of a break in data (see Appendix A), a dummy variable for wage freeze in 1979, 1988 and 1989 (Johansen, 1995), and a dummy variable for 1958. There was an extraordinary wage increase in 1958. The equation for teacher input per class is similar to (B2), but ξ_t now represents a constant and a dummy variable for 1973–1990 at level and at differenced form because the definition of part-time teachers changed in 1973. The variables vac, female and debt are only included with lags because of possible simultaneity. Homogeneity of degree zero in nominal values is not imposed in the short run when inflation is included.

If an error-correction term (capturing variables which are $I(1)$) is not stationary, there is no cointegration. In terms of equations (B1) and (B2), when the expected values of $\eta_0 + \eta_1$ and μ_0 are zero, the models have no long-run effects. The error-correction-based test for cointegration suggested by Kremers *et al.* (1992) utilizes this property. The test statistic is the *t*-value of $\eta_0 + \eta_1$ or β_0, and because these parameters are not normally distributed, Kremers *et al.* suggest the Dickey–Fuller test statistic for time-series properties as a conservative critical test value. We also test for stationarity by simply testing the time-series properties of the stochastic error term, which has to be integrated of order zero if the model is balanced.

The results of the reduced economic models and test statistics are shown in Tables B2 and B3 columns 1a and 1b. In columns 2a and 2b, the political variables are included, and these models are again reduced in columns 3a and 3b. The results are very similar to the results for the period 1880–1990 in Falch and Rattsø (1995), but with fewer significant effects. All models have long-run effects. Non-cointegration is rejected by the test of Kremers *et al.* in all models, and the error terms are clearly integrated of order zero. The model specification tests are well below critical values.

Table B2. Determinants of local government decision

	Class size ($st-cl$)			Non-teacher spending per student ($sp-st$)		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
$(st-cl)_{t-2}$	−0.488	−0.423	−0.508	—	—	—
	(9.33)	(4.62)	(9.39)			
$(sp-st)_{t-1}$	—	—	—	−0.604	−0.872	−0.629
				(4.61)	(3.18)	(5.27)
g_{t-1}	—	—	—	0.604[R]	0.552	0.629[R]
					(2.48)	
$(w_T+(t-cl))_{t-1}$	—	—	—	−0.604[R]	−0.581	−0.629[R]
					(1.63)	
$(st-n)_{t-1}$	0.205	0.176	0.219	—	—	—
	(8.26)	(3.32)	(8.76)			
cent_{t-1}	0.063	0.067	0.070	—	—	—
	(6.78)	(5.53)	(7.83)			
div_{t-1}	−0.033	−0.043	−0.037	—	—	—
	(6.19)	(3.95)	(7.24)			
$\Delta(st-n)_t$	0.639	0.381	0.453	−3.081	−5.538	−2.983
	(4.60)	(2.40)	(3.07)	(3.78)	(2.12)	(4.03)
$\Delta(st-n)_{t-1}$	−0.639[R]	−0.355	−0.453[R]	—	—	—
		(2.03)				
$\Delta\log(1-m)_t$	—	—	—	−0.299	−0.202	−0.291
				(3.15)	(1.38)	(3.37)
$\Delta\text{elderly}_t$	0.443	0.539	0.482	—	—	—
	(1.99)	(1.84)	(2.33)			
$\Delta\text{elderly}_{t-1}$	−0.443[R]	−0.396	−0.482[R]	—	—	—
		(1.51)				
SDM_t	—	−0.007	−0.006	—	—	—
		(1.23)	(1.97)			
TBC_t	—	0.000	—	—	—	—
		(0.06)				
SOCL_{t-1}	—	−0.058	—	—	−0.189	—
		(0.71)			(0.27)	
ΔSOCL_{t-1}	—	0.164	0.089	—	1.170	0.801
		(2.39)	(2.08)		(1.73)	(1.96)
HERFL_{t-1}	—	−0.098	—	—	−1.176	—
		(1.16)			(0.89)	
Sample	1948–1990	1948–1990	1948–1990	1974–1990	1974–1990	1974–1990
R^2	0.910	0.938	0.928	0.722	0.826	0.789
SSR	0.00050	0.00035	0.00040	0.0097	0.0061	0.0073
DW	1.56	1.58	1.47	2.30	2.62	2.35
AR	1.676	1.282	2.422	1.160	2.210	1.300
DF	−5.137	−5.140	−4.849	−5.360	−5.927	−5.785
CHOW	0.667	0.773	0.687	0.743	0.185	0.409
WALD	0.066	—	0.953	0.210	—	0.267

Estimated absolute t-values in parentheses. SSR is sum of squared residuals; DW is Durbin–Watson statistic; AR is an LM-test for autocorrelation of order 1 (Kmenta, 1990, p. 333); DF is Dickey–Fuller test of unit root of residuals; CHOW is the Chow test for parameter stability (p. 431); break point is 1975 in the equation for class size and 1983 in the equation for non-teacher spending per student; and WALD is a Wald test for liner restrictions (p. 492) where [R] denotes restricted coefficient. F-forms presented.

Table B3. Determinants of central government bargaining

	Teacher consumer wages, w			Teacher input per class $(t-cl)$		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
w_{t-1}	−0.279	−0.290	−0.287	—	—	—
	(6.94)	(5.34)	(6.99)			
$(t-cl)_{t-1}$	—	—	—	−0.165	−0.193	−0.119
				(5.43)	(2.81)	(5.97)
gdp_{t-1}	0.279[R]	0.298	0.287[R]	0.165[R]	0.149	0.119[R]
		(4.43)			(2.92)	
$(st-n)_{t-1}$	0.093	0.101	0.125	—	—	—
	(2.73)	(1.59)	(3.90)			
$cent_{t-1}$	—	—	—	0.084	0.058	—
				(3.50)	(1.06)	
vac_{t-1}	0.022	0.026	0.025	—	—	—
	(3.08)	(2.98)	(3.73)			
$debt_{t-1}$	−0.110	−0.129	−0.115	−0.081	−0.044	—
	(6.58)	(2.94)	(6.03)	(3.70)	(1.33)	
$\Delta(st-n)_t$	−1.952	−2.133	−1.991	−0.599	−0.363	—
	(6.15)	(5.20)	(6.14)	(3.32)	(1.29)	
$infl_t$	−0.740	−0.687	−0.658	−0.105	−0.073	—
	(9.02)	(7.10)	(8.10)	(1.90)	(1.17)	
$\Delta female_{t-1}$	−0.550	−0.463	−0.350	0.222	0.311	0.389
	(5.17)	(3.06)	(2.61)	(3.49)	(3.12)	(6.51)
D58	0.032	0.025	—	—	—	—
	(2.16)	(1.68)				
D7390	—	—	—	−0.054	−0.051	−0.042
				(6.62)	(3.53)	(7.31)
ΔD7390	—	—	—	0.023	0.021	0.021
				(2.19)	(1.47)	(2.14)
SDM_t	—	0.025	0.020	—	0.007	—
		(1.73)	(1.94)		(0.66)	
TBC_t	—	0.003	—	—	—	—
		(0.00)				
$SOCN_{t-1}$	—	−0.115	—	—	−0.037	—
		(0.34)			(0.21)	
$\Delta SOCN_{t-1}$	—	0.181	—	—	0.142	—
		(0.87)			(0.92)	
$COAL2_{t-1}$	—	0.011	—	—	0.004	—
		(0.92)			(0.44)	
$COAL3_{t-1}$	—	−0.010	—	—	0.000	—
		(0.54)			(0.01)	
$DURN_{t-1}$	—	−0.0011	−0.0011	—	−0.0007	—
		(0.11)	(1.97)		(1.13)	
$HERFN_{t-1}$	—	−0.092	−0.198	—	−0.191	−0.288
		(0.63)	(1.90)		(1.94)	(5.44)
R^2	0.883	0.918	0.902	0.710	0.793	0.728
SSR	0.0064	0.0045	0.0054	0.0029	0.0021	0.0027
DW	1.42	2.13	1.91	2.16	2.51	2.33
AR	3.885	0.167	0.078	0.726	3.744	1.766
DF	−4.764	−6.834	−6.130	−7.876	−9.182	−8.293
CHOW	0.576	0.935	0.804	0.633	1.001	0.292
WALD	0.840	—	0.080	0.040	—	0.545

Notes: See Table B2. The period is 1948–1990. Break point for the Chow test is 1975.