Decentralization and the Productive Efficiency of Government: Evidence from Swiss Cantons

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Abstract

Advocates of fiscal decentralization argue that amongst other benefits, it can increase the *productive efficiency* of delivery of government services. This paper is one of the first to evaluate this claim empirically by looking at the association between expenditure decentralization and the productive efficiency of government using a data-set of Swiss cantons. We first provide careful evidence that expenditure decentralization is a powerful proxy for factual local autonomy. Further panel regressions of Swiss cantons provide robust evidence that more decentralization is associated with higher educational attainment. We also show that these gains lead to no adverse effects across education types but that male students benefited more from educational decentralization closing, for the Swiss case, the gender education gap. Finally, we present evidence of the importance of competence in government and how it can reinforce the gains from decentralization.

JEL: H40, H52, H70, I20

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1. Introduction

Fiscal decentralization, the allocation of tax and spending powers to lower levels of government, is now an established policy objective, in many developed and developing countries. Moreover, it is actively promoted as a development strategy by organizations such as the World Bank (Azfar et al., 2001, World Bank, 2000). The usual advantages that are claimed for decentralization that one can find in the literature include the following (Azfar et al., 2001, Lockwood, 2005, Oates, 1999). First, decentralization is claimed to improve *allocative efficiency*, in the sense that the goods provided by governments in localities will be better matched to the preferences of the residents of those localities. This is sometimes known as the *preference-matching* argument. Second, decentralization is argued to increase the *productive efficiency* of delivery of government services. In this literature, production efficiency is interpreted in a wide sense, to accommodate inefficiencies like corruption, waste, and poor governance. There is now quite a large literature on decentralization and allocative efficiency[1]. By contrast, the literature on decentralization and productive inefficiency is small.

The theoretical literature identifies two mechanisms by which decentralization may lead to increased productive efficiency. The first is that decentralization may give voters increased electoral control over incumbents. For example, Seabright (1996) and Persson and Tabellini (2000, Chapter 9), decentralization is shown, under some conditions, to reduce the incentives for incumbents to divert rents from tax revenue, because under decentralization, the (negative) link between such rent diversion and the probability or re-election is stronger. Hindriks and Lockwood (2005) extend this argument to show how decentralization may increase the equilibrium probability that corrupt incumbents are voted out of office (a stronger *selection effect* in the terminology of Besley and Smart, 2004). The second mechanism is via a decrease in lobbying by interest groups, which both distorts policy choice and increases waste of public funds. Here, a small number of contributions by Bardhan and Mookherjee (2003), Bordignon, Colombo, and Galmarini (2003), and Redoano (2003) emphasise that the link between decentralization and lobbying is ambiguous. Indeed, under some conditions, there can be more lobbying and distortion of policy choice under decentralization, confirming the belief, going back to the US Federalist Papers in the 18th century, that local government is more susceptible to "capture" by lobbies.

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[1]See for example, Alesina and Spolare(1997), Besley and Coate (2003), Bolton and Roland (1997) and Cremer and Palfrey (1996), Ellingsen (1998), Gilbert and Picard (1996), Lockwood (2002), Oates (1972), Oberholzer-Gee and Strumpf (2002), Seabright (1996), Wallis and Oates(1988).

The existing empirical literature does not try to precisely identify either of these mechanisms. Rather, the approach is to look at a reduced-form relationship between fiscal decentralization and some indicator of the efficiency of government. This literature is, to our knowledge, exclusively based on cross-country data. The level of fiscal decentralization is usually[2] measured by the percentage of government expenditures made, or taxes collected, at sub-national level, as recorded by the IMF's Government Financial Statistics. These papers then run regressions where the dependent variable is some easily measured and internationally comparable outcome of government activity against the preferred decentralization measure together with a set of controls. For example, in Khaleghian, 2003, the outcome is immunization coverage rate in the population Treisman, 2002, used immunization coverage also, along with basic drug availability, youth illiteracy rates, and the number of kilometers of paved road per resident of the country. Alternatively, some papers use as the dependent variable some more general indicator of government effectiveness (Huther and Shah, 1998), or corruption (Mello and Barenstein, 2001, Fisman and Gatti, 2000).

In our view, there are two main problems with this literature. First, many of these papers rely on the IMF measure of fiscal decentralization which - it is widely recognised - does not measure very accurately the true autonomy of sub-central government to choose expenditures and set taxes[3]. Second, these regressions do not estimate government "production functions", because they do not control for the *inputs* to the output that is the dependent variable. For example, several papers that study health outputs do not control for health expenditures, number of doctors, etc. In the absence of controls for these inputs, these regressions can not tell us much about the efficiency of government as any observed correlation between decentralization and government output can be attributed

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[2]Triesman (2002) is an exception here: he uses several different constitutional indicators of decentralization, such as a dummy variable for a federal country, the number of different tiers of government, etc.

[3]For a critique of the IMF's Government Finance Statistics. the use of these statistics as measures of the true autonomy of local governments, see Ebel and Yimaz(2002). These statistics tend to overestimate the share of government expenditure and tax revenues that are under the control of sub-national government, and they do so in a way that varies widely across countries. For example, consider a country (e.g. Germany) where some taxes are set nationally but where the revenues are shared with sub-national governments via a fixed formula. The share of tax revenue going to sub-national government is measured in the IMF's statistics as sub-national revenue, even though the lower level of government may have little or no control over choice of the rate or the base. Similar problems appear on the expenditure size from spending that is mandated by central government but implemented by lower-level governments.

to omitted variable bias.[4]

To confront these criticisms, our paper uses data on fiscal decentralization and educational inputs and outputs from Swiss cantons over the period 1982-2000. There are several advantages of these data. First, there are data on the level of fiscal decentralization of spending on education within each Canton, collected on a consistent basis over Cantons and years. So, this indicator is likely to be a much better indicator of true fiscal autonomy than in the cross-country case. Moreover, the spending relates to education only, and so there is no danger of the kind of aggregation bias that arises when using the decentralization of *total* expenditure as an indicator, as do the studies cited above.

As an additional check on this, we study the relationship across Cantons between the spending measure of decentralization and various direct measures of sub-cantonal autonomy in educational policy, specifically, which level of government has the authority to appoint teachers and/or determine their pay level, whether the local government has the power to set incentive pay, and whether they have some powers over the organization of the school or curriculum. There is a strong positive correlation between the expenditure measure and an index of these direct measures. Second, in contrast to the existing literature, as well as measuring "output," we can control for the influence of inputs on educational outputs, such as educational expenditure per pupil and class size. In our sample the education output in a given year is the fraction of school students that obtain the Maturité certificate that allows continuation to university.

Our main finding is that there is a robust positive relationship between fiscal decentralization and productive efficiency of public good provision in the case of education. This is present even when canton and year effects are allowed for, and when fiscal decentralization is instrumented by urbanization. Finally we find no empirical support that the gains were accompanied by losses in terms of other measures of educational attainment.

We also take our investigation further by asking whether other - possibly time-invariant - features of cantonal and local government interact with decentralization of education to affect the Maturité pass rate. We find that a five-year moving average of both cantonal and local budgetary surplus (which we take to measure "good governance", following Galiani. and Schargrodsky, 2002) has a positive interaction effect on the pass rate. So, a given amount of decentralization will lead to greater efficiency gains if either cantonal or local government is competent.

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[4]For example, if it is found that decentralization is positively related to immunization rates (as does Khaleghian, 2003), this could simply reflect the fact that decentralized countries spend more on immunization, not that they can deliver this service with greater efficiency.

We also find, that the number of local jurisdictions in a canton (which we take to measure possible economies of scale) has a negative interaction effect on decentralization. This is consistent with theoretical predictions, centralizing expenditure on education will have greater efficiency gains - or rather, smaller losses - when the scope for economies of scale is larger.

The rest of the paper is laid out as follows. Section 2 describes the context of decentralization in Switzerland. Section 3 assesses the extent of local autonomy across cantons and its relationship to expenditure decentralization. Section 4 then turns to the empirical evidence of expenditure decentralization and educational attainment. Section 5 concludes and discusses the results.

2. Decentralization in Switzerland

Let us now turn to a description of decentralization and publicly provided goods in Switzerland. We will describe both time invariant and time variant factors and their variation across cantons.

Switzerland is a Confederation of 26 cantons. These cantons are independent from the federal government in terms of school-level education and most aspects of the day-to-day life in which the state is involved. These 26 Cantons are further divided into 2896 local counties. Figure 1a and 1b show the location of the local counties and the 26 cantonal capitals. It is notable that the topology is very influential for the spatial distribution of the local counties as these counties are lined up in the valleys in the south of the country and the plains in the north. This geographic pattern suggests the importance of taking into account factors that are specific to a canton as we will show below. Table 1 gives for each canton the number of local counties, the average population size per county and the average surface per local county.[5]   As it is apparent, the number of local counties per canton, also referred to as fragmentation, is driven by population size. A simple correlation between population size in a canton and the number of local counties is 0.69, so more populous cantons have more local counties. Despite this high correlation between population size and the number of counties there is still a large variation in the degree of administrative decentralization. This can be measured by the average population per local county in a canton.   For instance at the end of the 1990s, there are 232 counties in Aargau which has a total population of 539361 and thus the average population per

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[5]The average surface is based on the total polygonal surface for each canton minus the non-prodcutive surfaces, i.e. lakes, glaciers, rocks, etc.

local county is 2325. There is a strong variation across cantons with Jura having 831 inhabitants per county on average and, at the other extreme Basel-City has an average population size of 63338 per county. As the number of counties does not vary over time we control for this by fixed effects for the case of education.

The factors so far refer to time invariant factors which will be captured by canton fixed effects in the education regressions. We now turn to time variant measures of decentralization. A very prominent measure of decentralization, which we will rely on below, is the degree at which local counties are in charge of public expenditure. We construct a commonly used measure of expenditure decentralization in year t and in canton c, D_{ct}, to be

$$D_{ct} = \frac{\sum_l LE_{lct}}{\sum_l LE_{lct} + CE_{ct}} \tag{2.1}$$

where local expenditure in local county l in canton c in year t, is measured by LE_{lct} and cantonal expenditure in a given canton and a year by CE_{ct}. When all expenditures are carried out on the local level then $D_{ct} = 1$, and when the cantonal government is solely in charge of expenditure then $D_{ct} = 0$. An issue that is raised in the literature on federalism is the transfers across states via the federal government - or in our context between the cantonal governments and the local counties. In Switzerland, the local counties principally raise their own taxes to cover expenses and the transfers play, in general, a minor role in adjusting living standards across regions. More importantly is the issue as to what this definition of expenditure decentralization actually measures. In fact what we really want to get at is the autonomy in terms of public policy of the local counties with respect to the cantons. We will turn to this question in detail in the next section.

Another widely discussed factor in the determination of the degree of policy decentralization is the extent of preference heterogeneity (Oberholzer-Gee and Strumpf, 2002). In this paper we take the degree of preference heterogeneity and the number of local counties to be exogenously given. This we believe is justifiable given the relatively short time frame of the data set. This allows us to use heterogeneity, based on a measure of linguistic fractionalization to use as an instrument for decentralization.

We focus on the education sector as it is the area of public policy where decentralization has received most discussion in recent years (Hoxby 2000). A more important reason to look into this sector, however, is that schooling is under the joint jurisdiction of the cantons and the local counties who then decide the degree of delegation and decentralization to the local counties. This means that the federal government - in contrast to cantonal and local government - is not involved in the legislation and implementation of policies. For the

education sector we see in Table 1 that the average level of decentralization in Switzerland is 0.55, that is about half of all expenditure on primary and secondary education in a canton is spent by the local counties. Figure 2 presents a graph showing more clearly the variation in decentralization across cantons based on their average values for 1981-1999. Whereas Basel-City is a very centralized canton along this measure, Obwald is almost entirely decentralized. In Figure 3 we show the variation for each canton's degree of decentralization over time. Two facts are apparent. First there is sufficient variation within each canton for meaningful fixed effects regressions. Second, there is no general discernible trend towards more decentralization of centralization over time.

In summary we can see that even if the administrative structure is driven by the size of each canton, large variations remain both across and within cantons.

3. Local autonomy in the provision of education

Although expenditure decentralization is now widely used in the empirical literature on decentralization one can wonder what it actually measures. In fact could it not just be that money is spent at the local level but without any form of *autonomy* as to what the money is spent on? This question has been raised repeatedly when the effect of decentralization has been assessed on a cross-sectional but is also in panel data. Comparing countries along a certain dimension - that of expenditure decentralization - raises two issues. First, is data collected and defined identically across countries? Second, what does expenditure decentralization actually measure?

On the first question we have to recognize that impressive improvements have been made in recent years to better the international comparability of data across countries. Yet we can still question with reason if the data from countries with very different levels of development are comparable. This is, we believe, the most compelling reason to turn to within country data instead where we can be more certain that measurement, data collection, storage and publication is consistent across states and coherent over time.

The second question has also been referred to as the *proxy question* (Hanushek et al. 2002). It asks whether a variable can serve as a good approximation to reflect a theoretical variable or concept. This is particularly important when we want to know when an easily observable variable is successful in capturing an underlying variation in a variable that is more difficult to measure.

In our context we took a close look at the actual legislation in Switzerland in order to see if higher expenditure decentralization is also accompanied by more local autonomy. Anticipating the result of this section we do find evidence that cantons with more local

expenditure are those that grant more autonomy to the local governments and therefore expenditure decentralization is a powerful proxy for local autonomy.

3.1. Legal background

To assess local autonomy we will focus on the provision of education. In order to get a detailed and precise insight into which decisions are under the responsibility of the local governments we read through the legislation of each of the 26 cantons pertaining to the organization of schools, the selection of teachers, and their compensation.

The Swiss education system can be concisely described by a primary school level, a lower secondary school level, and, finally by an upper secondary school level. The first two school levels comprise the nine years of compulsory education. The third level, with a duration of four to five years, offers the university entry qualification, called the maturité, at its end.[6]

Many responsibilities are common across all cantons in the way they are shared between the local and the central government. Common features among all cantons are that the primary school is the exclusive responsibility of the local communities and many aspects of the upper secondary school is under the jurisdiction of the cantonal government. School material and the definition of aims, scope, and structure of school at all three levels are regulated by cantonal, i.e. central, law. Organizational issues concerning the day-to-day running of the schools like the allocation of pupils to classes, the enforcement of discipline at the school, and ensuring that pupils attend class are under the competence of the local counties. As a related point a note concerning school choice is in order. As in most OECD countries pupils are guaranteed a place in a school within the 'catchment area' of residence.[7] Furthermore pupils can only attend schools of another area under exceptional circumstances. Education is free for residents of a canton but school fees can be levied for pupils residing outside the canton; 95% of pupils in Switzerland attend public schools. So as such pupils and parents only have a choice of school via the choice of residence. However unlike the US and the UK where the relative performance of schools

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[6]There also exist professional schools that qualify students for field-specific tertiary education but we will abstract from those qualifications.

[7]See for instance in Appenzell-Ausserrhoden art. 20 Schulgesetz, par 1. (Also in art 20.3 states that when pupils from another local county attend school than financial support can be requested from that county to help in the financing of those pupils; in Bern art. 7, Volksschulverordnung (VSV) 432.211; in Freiburg art. 8, Schulgesetz and also "Gesetz ueber den Mittelschulunterricht"; in Nidwald art. 11 Volksschulgesetz (312.1); in St. Gallen art.s 52 and 53 Volksschulgesetz;in Solothurn art. 45, Volksschulgesetz, or in Schwytz art. 32 Verordnung über die Volksschulen.

across and within areas is well documented and made public, no generalized information of this kind exists in Switzerland. Even if it is true that parents get informed through casual observations and discussions with other parents on their subjective evaluations, no authoritative objective evaluation is available. We therefore do not attempt to model specifically the implications of cross-border school-choice but allow for these effects to enter through error terms that are clustered spatially for each year.[8] Inspections and auditing of schools is present in all cantonal legislation and is made operational through external inspectors appointed by the central cantonal government.[9] They are in charge of training and evaluation of teachers, the supervision of school management, the observation of school curricula, and the use of teaching material, and the inspection of school locations.

3.2. Variation of responsibilities across cantons

We can, however, define four dimensions along which the level of autonomy varies across cantons. Table 2 describes in detail the legal sources, and the division of responsibilities and their actual form. The data sources contained therein reflects those of the current legislation as of August 2003. Where possible each legislations has been traced back to assess if within the sample period there have been changes to these laws; but no evidence for such changes have been found.

The purpose of this section is to see how actual legislation on local autonomy is related to observed decentralization. As the primary school is always under local and the upper secondary always under central jurisdiction we focus on the delegation of decisions at the lower secondary school. Specifically we identified who is in charge of:

- appointing teachers,

- determining the pay level of teachers,

- teachers' incentives, and

- structural school organization.

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[8]These issues have generated an exciting empirical literature in countries where objective measures are available to parents. See for instance Steve Machin and Steve Gibbons (2003) where they show how better school quality drives up property prices in England.

[9]For instance see the legislations of the cantons of Thurgau (art 5, 410.1 Unterrichtsgesetz, www.tg.ch), Valais (Titre 2, Chapitre 1, 400.1 Loi sur l'instruction publique, www.vs.ch), or Zug (art 67, 411.11 Schulgesetz, www.zg.ch)

The first point simply asks who selects and appoints teachers.[10]

The second dimension asks whether pay can be set at the local level. In most cantons, teachers' pay is regulated by the law on civil servants. Each teacher is allocated a pay class (or spinal point) depending on qualification, the type of occupation, and work experience. However in a few cantons the local counties can make additional payments to attract teachers or can independently generate their own pay system all together.

The third dimension of local autonomy concerns the presence of incentive pay set at the local level. Usually teachers, after being hired, are automatically promoted at the beginning of each academic year to the next salary class (or spinal point). However this progression can be put to halt should the performance of teachers be insufficient. Then teachers can either be kept on the same pay level or even relegated to a step further down the salary scale. What we wanted to assess is if the decision to inflict such punishment can be made on a local county level rather than at the central level. This form of autonomy is present in the cantons of Appenzell-Ausserrhoden, Glarus, Nidwalden, Zug and Zurich and to a certain extent (punishment requested by local authority and granted by cantonal government) in Basel-Landschaft. In the canton of St. Gallen teachers can be dismissed by the local counties. Apart from "sticks" some cantons allow the local counties to award its teachers "carrots". This can take on different forms. In Appenzell-Ausserrhoden, local governments can spend up to 0.2% of their wage bill on performance related pay. In Schwytz local councils can budget a specific credit - referred to as *Spontanhonorierung* (spontaneous reward) - of up to 0.3% of gross total wage pay. If this credit is granted by the legislative body, school councils can then reward teachers for their exceptional performance. In Zug, local councils are generally also allowed to make such bonus payments.

Of course, other forms of informal rewards and punishments can be imposed on teachers both from the local and the central level. But we take the presence of such provision as a deliberate intent by the cantons to give more autonomy to the local level of government.[11]

The fourth dimension concerns local autonomy in terms of school organization. Here we do not mean general tasks of day-to-day running of the school as they are always

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[10]In Switzerland just as in any OECD country, vacancies in the public sector are filled by the open tendering procedure as described in the section on public procurement.

[11]We also make no claims in this paper whether the presence of incentive pay as desirable or not. Indeed as these legislation is unlikely to vary over time we these factors will be absorbed by canton fixed effects. What we want to capture is if these incentive payments are determined on the local rather than the central level.

decided on the school or the county level. Instead we read the cantons' school legislation to see if local counties can in fact make important *structural decisions* of some kind. Here we find that four cantons can indeed make such choices. In two cantons the local counties can choose between different school models (Appenzell-Ausserrhoden and Zürich). In a further two - Solothurn and Valais - local counties can decide whether they want to introduce an additional 10th year of education.[12] Finally, the canton of Valais entitles the local counties to decide if they want to regroup pupils from different school years for reasons of effectiveness. For these cantons we classified the dummy variables in Table 2 as "local" as we take it to be evidence that some additional local autonomy in decisions exists.

For all these measures we refer the reader to the Table 2 for precise legal sources and for their classification of these four dimensions of local autonomy.

3.3. Results

In Table 3 we ranked cantons in descending order in terms of their level of education decentralization defined as the sum of local expenditures divided by all education expenditure, local and central, in a canton. We than give four columns that show if a canton allows for local autonomy in any of the four types of dimension mentioned above. This table reveals an interesting pattern: cantons with high levels of decentralization are more likely to have broader local autonomy. In particular one can see that cantons with more decentralization have a higher probability to give their local counties autonomy over teachers' incentive pay. A simple cross section regression analysis - not reported - makes this point more formally where we regress the level of decentralization on a set of dummy variables equal to one if in a local autonomy is present. Two categories have significant explanatory power: autonomy over teacher appointment and on teacher incentive pay is positively correlated with higher decentralization and over 70% of the variation in decentralization across cantons can be explained by a variation in autonomy. This result is also robust to the introduction of other control variables: cantons that are more fragmented in the administrative divisions - as measured by the population per local county - do have higher decentralization.

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[12] Compulsory education is nine years after which pupils either leave school, go to professional school or go to the Mittelschule prepearing for university. Many cantons however give pupils the option to stay on for one more year after the ninth year without giving an additional qualification. Except for these two cantons the presence of the 10th year is regulated by cantonal law and local counties can not choose to introduce when it is not present or opt out of it when it is.

We can thus conclude that autonomy is indeed related to expenditure decentralization in this specific context. These autonomy measures are not time variant and would therefore be absorbed by the canton fixed effects that capture all time independent effects of a canton in the regressions below. This section however provided reassuring evidence that these measures of decentralization are powerful proxies for actual local autonomy which should enhance the credibility of the regressions of the next section.

We will nevertheless also exploit in the next section the cross-section variation to assess if the effect of decentralization is a function of the extent of autonomy.

4. Decentralization and Educational Attainment

4.1. Empirical Strategy

We now turn to an econometric estimation of the relationship between decentralization and efficiency of public good provision in the educational sector. We will approach the estimation with a panel data set of 26 Swiss Cantons over the period 1982-2000. We have for each canton yearly observations on decentralization and various input measures. The advantage of looking at Swiss cantons are twofold. First data has been collected consistently and definitions of variables are coherent across cantons over the last 20 years which is an advantage over the studies based on international cross-sections; as documented in the previous section we have variation in the measure of decentralization and of educational attainment across time and across cantons. Secondly, we can exploit the panel structure and control for time-invariant and unobservable heterogeneity to account for heterogeneity in policy preferences and topological characteristics which are important factors in the interplay between decentralization and education.[13]

The objective of the estimation is to establish if decentralization is associated with educational attainment. As the measure of educational attainment is at the year level we need to model the total effect of covariates that affected a current cohort of 19 year olds over their schooling career.

We thus estimate the effect of decentralization in canton c in year t, on the educational attainment E_{ct} with

$$E_{ct} = \alpha_c + \beta_t + \gamma D_{ct}^{t-1,t-k} + \eta X_{ct}^{t-1,t-k} + u_{ct}. \tag{4.1}$$

All variables are converted into natural logarithms. The variable $D_{ct}^{t-1,t-k}$ contains a measure of the degree of decentralization that affected a cohort in period t in canton c

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[13]These have been shown to be important in the determination of district frontiers in Hoxby (2000).

over the past k periods. This allows to capture the effect a cohort experienced over their whole schooling career. Specifically in the regression we will model $D_{ct}^{t-1,t-k}$ by

$$D_{ct}^{t-1,t-k} = \frac{(D_{ct-1} + ... + D_{ct-k})}{k}, \qquad (4.2)$$

i.e. as a moving average of the past k periods. The next section will vary k to filter out the appropriate specification. In particular we will identify separately the effect during the whole schooling career, i.e. during the past 12 years, from the effect during the post-compulsory upper-secondary education, i.e. during the past 5 years, and during the primary and lower secondary education period, i.e. during the first seven years of education.

Similarly the vector $X_{ct}^{t-1,t-k}$ contains moving averages of the past k periods of further control variables capturing the quality of the human resources, schooling infrastructure, and per student expenditure. Finally α_c are canton and β_t are year fixed effects and u_{ct} are unobservable disturbance terms clustered at the cantonal level to allow for serial correlation. The precise specification will be explained and discussed below.

In order to make statements on the relationship between decentralization and efficiency of public good provision we maintain the identifying assumption on γ that given the set of other input variables it captures the effect on efficiency of institutional arrangements which in this case is decentralization. Thus denote efficiency by e_{ct} we assume that

$$e_{ct} = E(E_{ct}|\alpha_c, \beta_t, D_{ct}^{t-1,t-k}, \eta X_{ct}^{t-1,t-k}) \qquad (4.3)$$

where $E(.|.)$ is the expectation operator.[14]

4.2. Educational Attainment

We can now turn to a central question of the paper: Is the degree of decentralization related to higher productive efficiency of government? There is a vast literature on the economics of education that concentrates on the question as to which input measures affect educational attainment (Hanushek, 1997 and 2003). That literature has identified a number of input measures but found very mixed results with respect to the effect of input measures on educational attainment.

First, output is mostly measured by standardized test scores. Even if we do not have test scores available in Switzerland we have a very closely related measure namely the

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[14]An alternative estimation strategy it to run stochastic frontier regressions. All results presented in the following sections are robust to that estimation.

maturité rate which is the number of students who obtain the university entrance level qualification deflated by the number of 19 year old population. Overall in Switzerland in 2000 17% of the 19 year old population obtained the maturité which entitles them to attend university. This level of education is four to five years beyond the compulsory level of education in Switzerland. Numerous studies have shown how students who obtain this level of education have higher future income, better choice of jobs and subjective well-being. However, not all students who continue their education at the upper secondary school level, i.e. beyond compulsory education, attend schools that provide the *maturité*, but rather attend *professional schools* that also last four to five years past compulsory schooling. In the next section we will also address the effect of decentralization on *professional school degrees* but focus for the moment on *maturité rates.*

Second, in the education literature, the inputs are usually taken to be of two types: school characteristics, and the social composition of a student cohort.

Table 4 presents summary statistics of all variables.[15] We measure the school characteristics by class size and expenditure per student.[16] Second, for the social composition of the student population we have the proportion of students whose first language is different to the language of instruction: on average 16% of students are not instructed in their first language: on average 16% of students are no instructed on their first language. By this we want to control for the fact that more foreign students can reduce the educational attainment of a cohort as they may be more difficult to teach due to the language barrier; in a way we thereby capture the quality of the input.

This set of variables, together with canton and year fixed effects, go a long way to characterize the structure of input variables in a given canton and year. These are of course only a subset of variables and many other covariates contribute to the level of educational attainment of a specific individual such as the household or the neighborhood characteristics. However the focus of this paper is to identify the effect of the level of decentralization, which is measured at the cantonal level, and as such the identification and the bias of that coefficient is not sensitive to the omission of individual level data. See also Hoxby (2000) for a detailed discussion of this issue.

Table 5 turns to a set of panel regressions. In the first column we report a first cut at the data be regressing the educational attainment among the 19 year old population in a year as a function of decentralization during the past 12 years, i.e. the average effect of exposure to variations in decentralization during the time this cohort spent in school.

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[15]Variables are converted into natural logratihms and ratios are converted to $\ln(x + 1)$.

[16]This number excludes expenditure for tertiary education.

This regression is thus in the spirit of cross section regressions that ignore the problem of omitted variable bias induced by unobserved heterogeneity. [17] As can be seen there is a significant *negative* correlation between decentralization and educational attainment. However this can be due to many factors that are specific to a region. The importance of this omitted variable bias is revealed when we add canton and year fixed effects in column (2). Note that now the coefficient is significantly *positive* at the 10% level. This illustrates that it is not innocuous to ignore the potential for unobserved heterogeneity stemming from historical or cultural differences that can be correlated with the degree of decentralization. This can explain why in some studies using cross-section regressions a negative correlation has been found.

In column (3) we introduce our set of control variables. Per pupil expenditure, class size, and the share of non-native speakers are not related to educational attainment. The coefficient on educational expenditure has the expected positive sign just as larger classes are related to lower educational attainment. When we omit the least significant variables, class size and foreign language speakers, we find that expenditure per student is significant at the 10% level. Most notably however is that even after controlling for this last set of variables we find that decentralization is positively related to educational attainment at the 10% level.

4.3. Effect over time

So far the right hand side variables are the moving averages of the past 12 years, i.e. $D_{ct}^{t-1,t-12}$ and $X_{ct}^{t-1,t-12}$. In column 5 we identify separately the effect of changes in decentralization during the last 5 years of schooling, i.e. during the post-compulsory education at the upper secondary school, from the effect of changes during the first seven years of schooling;

$$E_{ct} = \alpha_c + \beta_t + \gamma_1 D_{ct}^{t-1,t-5} + \gamma_2 D_{ct}^{t-6,t-12} + \eta X_{ct}^{t-1,t-12} + u_{ct}. \qquad (4.4)$$

We find that it is in fact the changes in decentralization experienced during the last five years of education that matter. The coefficient γ_1 is significant at the 5% level but γ_2 is not significant. The coefficient on expenditure per student remains significant at the 5% level.

Looking at column (5), our preferred specification, we see that a one-standard deviation increase in decentralization, 0.147, is associated with an increase of 0.056 in decentralization. In other words across all cantons, a one-standard deviation in decentralization

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[17]See Bardhan (2002) for a review of the related empirical evidence.

is associated with 37% of a standard deviation increase in educational attainment. This effect is quite large given that a one standard deviation increase in expenditure is only associated with 12% of a standard deviation increase in educational attainment.[18]

4.4. Instrumental Variable Regression

One challenge to the established results so far is that the variation in the right hand side variables is either endogenous or is at least co-determined with the regressor which makes the interpretation of the coefficients difficult. To address these concerns we propose to run instrumental variable regressions to see if a case can be made for a plausibly causal relationship between decentralization and educational attainment.

It is notoriously difficult to find an instrument in the best of cases. The challenge is even greater here as we have a panel in which we wish to control for canton and year specific heterogeneity which, as we showed in the last section, are important controls. Thus we can not employ variables that vary in the cross-section only (Hoxby, 2000).

We therefore propose to use the level of urbanization in a canton as an instrument for the degree of decentralization. Urbanization is defined as the share of population in a canton living in urban areas which varies both across time and space. Overall in Switzerland the level of urbanization in the sample period is 71% with a standard deviation of 21%. The rational to use urbanization as an instrument for decentralization is the following: When more people move into urban areas the importance and the voice of these urban areas increases. All principal cities in Switzerland are divided into several urban local jurisdictions which means that many of these urban districts are adjacent to each other. Given that policies affecting these districts generate important spillovers there is an incentive to cooperation of the urban areas in the bargaining process over resources with the central government which represents more diffuse interests. Thus we would expect to see a positive correlation between urbanization and the degree of decentralization: stronger urbanized cantons with concentrated interests are better placed to claim resources and responsibilities than less urbanized cantons with more diffuse interests relative to the central government.[19]

In Table 6 we show the first and second stages of the IV regression. As can be seen urbanization is strongly significant in the first stage and has a positive coefficient.

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[18]Calculated as $(0.0994 * 0.1805)/0.151 = 0.1188$

[19]To compare it with the case of the U.K. when London becomes more important on a national level it strengthens the position of Ken Livingstone, the mayor of London, relative to the Prime Minister Tony Blair.

Furthermore the coefficient on decentralization remains robust to the instrumentation and it triples in size to 1.5. One caveat is that the sample is somewhat smaller as the data from urbanization is only available from 1985. However, it provides strong suggestive evidence that the reported regression results can be interpreted as a causal relationship.

4.5. Economies of Scale

It has often been argued that one crucial advantage of centralized provision of public goods is that it can benefit from economies of scale in the production process: it may be more efficient to focus the design, implementation, and maintenance of public goods in one place rather than have several jurisdictions simultaneously engage in the same production process. To assess if this claim holds in our context we proxy for the scope for economies of scale by looking at the number of jurisdictions in a canton.[20] The more jurisdictions the less efficient in terms of economics of scale. We thus estimate the following model:

$$E_{ct} = \alpha_c + \beta_t + \gamma D_{ct}^{t-1,t-5} + \rho(D_{ct}^{t-1,t-5} \times J_c) + \eta X_{ct}^{t-1,t-12} + u_{ct}. \tag{4.5}$$

The variable J_c measures the number of jurisdictions in a canton. Note that even though the number of jurisdictions is time-invariant, the interaction term is identified by the cross-sectional variation. The empirical prediction is that the interaction term is negative, i.e. $\rho < 0$: decentralizing is more efficient when there are fewer jurisdictions involved in the process. Among the Swiss cantons the number of jurisdictions varies considerable between 3 in Basel-Stadt and 400 in Bern. Figure 4.1 below gives a kernel density of jurisdictions across cantons. In Table 7 column (1) we report results using the same sample as in Table 5. We restrict the specification to those variables that were significant in Table 5 column (5). As can be seen the coefficient on the interaction term is negative and significant at the 5% level. The coefficient on decentralization γ_1 now increases to 0.6. This is mainly due to the presence of the interaction term: the mean number of jurisdictions is 111 in the data set and therefore the average effect of decentralization is 0.44[21]. Increasing the number of jurisdictions by 50 reduces the effect of decentralization on education by 0.1. Thus there is strong evidence that economies of scale have a strong impact in the context of decentralization.

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[20] An alternative measure is to use population per jurisdiction which yields qualitatively similar results to the one presented in Table 6. Similarly the estimated effect is robust to the inclusion of population size as an additional control variable.

[21] Calculated as $0.6619 - 111 \times 0.00199$.
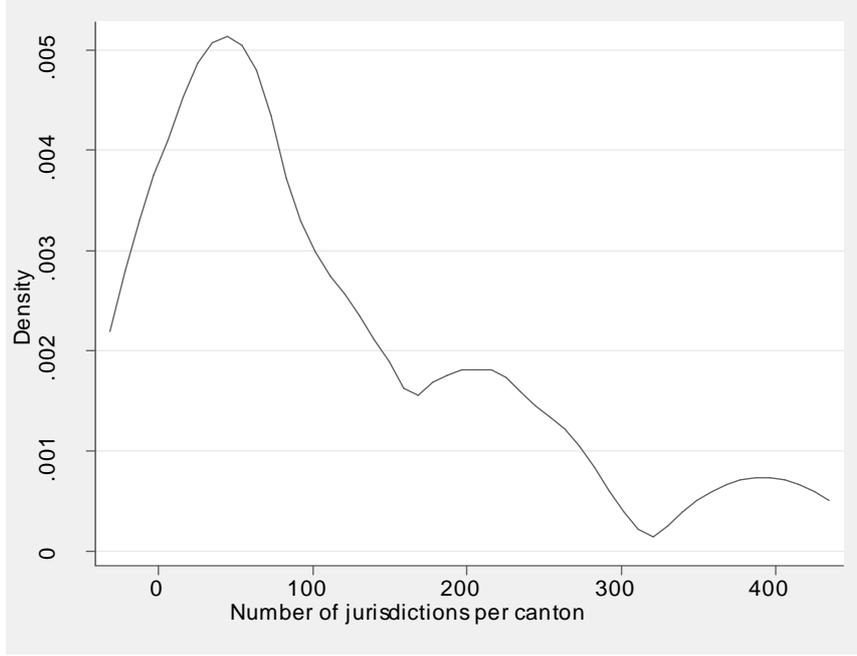
Figure 4.1: *Kernel density of the number of jurisdictions across Swiss Cantons.*

4.6. Decentralization and Autonomy

In the previous section we assessed if expenditure decentralization is a valid proxy for autonomy. The question we now turn to is to ask if decentralizing towards more autonomous regions has a different effect on education than to decentralize to regions with lower autonomy. This allows us to shed light on two questions. First, if we find that the effect of decentralization is a function of autonomy the proxy argument of the last section may be weak as autonomy does indeed pick up aspects that decentralization does not. Second, there is an active debate in the institutional literature surrounding decentralization if expenditure decentralization should be accompanied by increased autonomy or not. The argument there is that decentralization can only fully develop its potential benefits when it is accompanied by more factual independence of the local jurisdictions.

To take these questions to the data we estimate the following specification:

$$E_{ct} = \alpha_c + \beta_t + \gamma D_{ct}^{t-1,t-5} + \tau(D_{ct}^{t-1,t-5} \times A_c) + \eta X_{ct}^{t-1,t-12} + u_{ct}. \qquad (4.6)$$

Here A_c is a dummy variable equal to one when local decision taking is more autonomous. Specifically we set $A_c = 1$ in those cantons where teachers' incentive pay is determined at the local rather than at the central level, it is equal to $A_c = 0.5$ when

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the decision is taken at both levels, and $A_c = 0$ when the decision is taken centrally.[22] Of the 26 cantons in twelve the decision is taken locally, in four cantons the decision is taken jointly by the central and local authorities, and the remaining ten implement performance related pay at the centre. Note again that even though the autonomy measure is time-invariant, the interaction term is identified by the cross-sectional variation.

In column (2) of Table 7 we present regression results with the added interaction term. The coefficient on the interaction term is not significant.[23]

This results seems to suggest that the proxy assessment in the previous section is valid. It also suggests that, at least for this context and for the variables employed, we find no evidence that combining expenditure decentralization with autonomy has an additional effect on the outcome. To assess this interpretations further would require to have more dimensions along which autonomy varies across regions in order to filter out which type of autonomy matters - which is beyond the scope of this data set.

4.7. Decentralization and Budgetary Competence

A further criticism of decentralization is that the competence of local politicians standing for election may be lower than those standing for positions in the central government. This may be due to the fact the holding an office at the local government is less prestigious than at the central government. These issues can be particularly acute in the context of developing countries, as discussed in Bardhan (2002), where the competence of local public officials is often very low. To assess this second argument we follow the methodology in Galiani and Schargrodsky (2001). In that paper, competence of a government is proxied by the size of the budgetary surplus. Low or negative surplus, i.e. deficit, is interpreted to be associated with less competent governments. In contrast to Galiani and Schargrodsky (2001) we have data not only on the level of budgetary surplus at the central but also at the local level. To assess the effect of decentralization jointly with the level of competence we estimate the following model:

$$E_{ct} = \alpha_c + \beta_t + \gamma D_{ct}^{t-1,t-5} + \upsilon_L(D_{ct}^{t-1,t-5} \times SL_{ct}) + \upsilon_C(D_{ct}^{t-1,t-5} \times SC_{ct}) + \eta X_{ct}^{t-1,t-12} + u_{ct} \quad (4.7)$$

Here SL_{ct} measures the budgetary surplus of all *local* governments in a canton as a percent of cantonal GDP; SC_{ct} measures the budgetary surplus of the *central* government

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[22]We focus on this measure as the other measures exhibit little variation across cantons.

[23]In the specification reported in Table 6 we also keep the interaction term with local jurisdictions which has been found to be an important variable to avoid misspecification. Even if we drop that variable, the coefficient τ remains insignificant.

as a percent of cantonal GDP. Thus υ_L measures the effect of decentralizing *towards* local governments with a relatively high level of competence and υ_C measures the effect of decentralizing *away from* a central government with a relatively high level of competence.

In column (3) of Table 7 we see that $\upsilon_L > 0$ and $\upsilon_C < 0$ but only the coefficient on υ_L is significant. This is evidence that decentralizing *towards* a region that has a high level of budgetary competence translates into more gains, i.e. $\tau_L > 0$, in educational attainment than in regions with lower competence. Equally, decentralizing *away* from a competent central government, as $\tau_C < 0$, reduces the gains from expenditure decentralization.

This result gives support to the notion that competence - even in a developed country like Switzerland - needs to be taken into account in the decision over the degree of decentralization.

4.8. Adverse effects of decentralization

So far we have found evidence that decentralization is associated with better educational attainment as measured by maturité rates. It is important, however, to test if these gains were accompanied by losses along other dimensions. We focus on two types of adverse effects.

First, we ask is these gains in educational attainment are gender specific, i.e. if the gains to one gender has been accompanied by losses for the other. There are various reasons why decentralization leads to more targeted outcomes. If decentralization is increasing responsiveness to the median voter in each region then the preferences of this voter will change the policy choice. Central governments on the other hand are argued to be more able to redistribute gains to minority interests that are less well represented at the local level. Figure 4.2 presents educational attainment by gender - as measured by the maturité rate - across all Swiss cantons in the sample period. In the case of Switzerland, there are now more women than men obtaining this degree as a share of 19 year old female and male population respectively. Table 8 presents panel regressions where now the dependent variable is the maturité rate among women in column (1) and the maturité rate among men in column (2).[24] For the case of female educational attainment, decentralization has a positive effect but it is not statistically significant. Only expenditure is significantly related to the female maturité rate. In column (2) we repeat the same exercise but now for male students only. Here decentralization has a strong and significant effect on men; equally the economy of scale affect and the budgetary competence

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[24]The sample is somewhat smaller as educational attainment by canton and gender is not available for the year 2000.
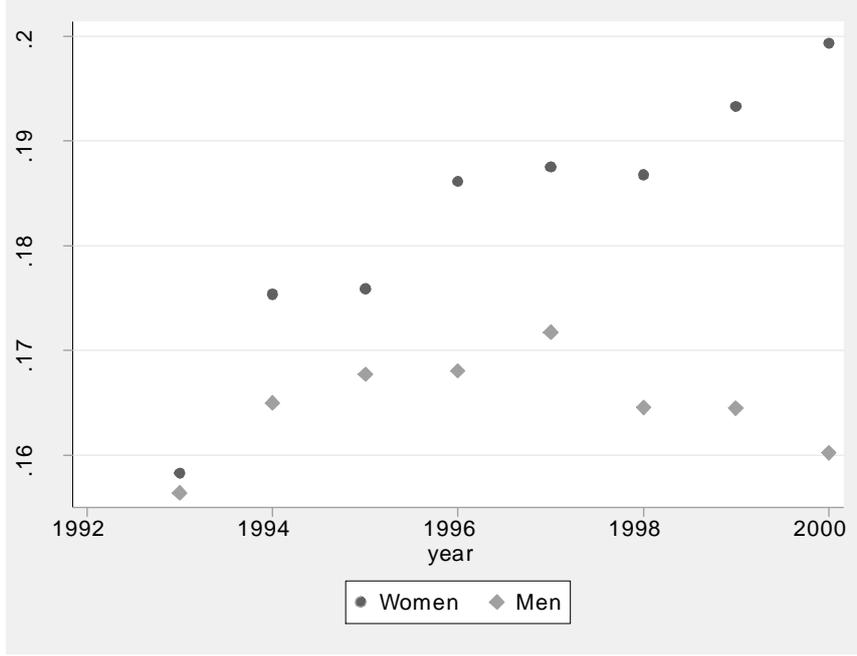
Figure 4.2: *Maturité rate among women and men in Switzerland as a share of 19 year old female and male population.*

effect only comes into play for male students but not for female students. Given that the gains have accrued more to men than to women we also estimated a gender education gap model - not reported - where the dependent variables were

$$gap_{it} \quad = \quad E_{it}^{female} - E_{it}^{male} \tag{4.8}$$

$$|gap_{it}| \quad = \quad \left| E_{it}^{female} - E_{it}^{male} \right| \tag{4.9}$$

We do not, however, find[25] that decentralization significantly increased the gender gap in education neither in relative nor in absolute terms.

Second, we assess if the gains in terms of maturité rates has been accompanied by a decline at other degrees. Among post-compulsory education the modal group of students attends professional schools rather than maturité schools. For instance in 2000 17% of 19 year old students obtained the maturité but 57% obtained a degree from a professional school. In column (3) of Table 8 we estimate a model where the dependent variable is the share of 19 year olds that obtain a degree from a professional school. We find that decentralization had no effect on that level of education.

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[25] Results are available from the authors.

In summary, we find no evidence for adverse effects of decentralization. More local expenditure is associated with better education among men but that has not been to the detriment of education among women nor did it significantly affect the gender gap in education. Similarly other degrees like those obtained from professional schools are not related to decentralization. Therefore is seems that decentralization is associated with a net gain in terms of educational attainment.

4.9. Party competition

So far the empirical strategy did not take into account the political environment which could also have a bearing on the efficiency of public good provision. A central argument in the political economy literature is that the advantage of democracies is that through the competitive pressure between parties, governments have an incentive to exert more effort when in office when they are under threat to be replaced by a challenger. To control for this effect we constructed a measure of party competition of the central government.[26]

$$PC_{ct} = \frac{s_{ct}^{\mathsf{I}} - s_{ct}^{\mathsf{C}}}{s_{ct}^{\mathsf{I}} + s_{ct}^{\mathsf{C}}} \tag{4.10}$$

where s_{it}^{I} is the number of seats in parliament of the incumbent party and s_{ct}^{C} is the number of seats in parliament by the challenger. The idea is that the when PC_{it} is close to zero, competition is very fierce for reelection which gives the incumbent party stronger incentives to perform while in power. When PC_{it} is positive and large, competitive pressure is weak.

We implement this measure by proxying s_{it}^{I} by the seat share of the largest party in a cantonal parliament and s_{it}^{C} by the seat share of the second largest party in government. We then estimated;

$$E_{ct} = \alpha_c + \beta_t + \gamma D_{ct}^{t-1,t-5} + \kappa(D_{ct}^{t-1,t-5} \times PC_{ct}) + \phi PC_{ct} + \eta X_{ct}^{t-1,t-12} + u_{ct} \tag{4.11}$$

The prediction would be that $\phi \geq 0$ but $\kappa \leq 0$: Party competition affects outcome directly and decentralizing away from a competitive central government is thus reducing educational attainment. Regression results - not reported - using these additional control variables showed that neither the coefficient on party competition κ nor on the interaction term ϕ is significantly different from zero and the coefficient on decentralization γ is unaffected.

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[26]No comprehensive data is available on the party composition of the local governments.

This results also sheds some light, even if indirect, on the discussion whether decentralization increases matching of policy to preferences. In our case this can not be reconciled with the data as then we should have found that party competition at the centre diminish efficiency gains from decentralization.

5. Conclusions

We investigated the empirical evidence on the relationship between decentralization and efficiency of public good provision. As a first step we looked at the current legislation in the Swiss cantons to provide careful evidence on the positive relation between expenditure decentralization and local autonomy in decision. We then proceed to panel regressions of data from Swiss cantons for the last 20 years. We saw that even after controlling for other input variables the degree of decentralization is positively related to educational attainment. We take this to be novel and consistent evidence that contradicts earlier cross-section findings that decentralization worsens governance (Treisman, 2002). Indeed it is the quality of data and the correct specification of the model that helps to uncover the precise effect of decentralization on the efficiency of public good provision.

We also find evidence that expenditure decentralization and local autonomy are substitutes rather than complements and that expenditure decentralization is more beneficial when local governments are more competent or, equally, when central governments are less competent.

These results shed new light on the empirical relevance of decentralization and the conditions under which it can attain its often claimed aim of improving the efficiency of public good provision.

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Figure 1a: Switzerland

Figure 1b: The location of local counties and cantonal capitals in Switzerland
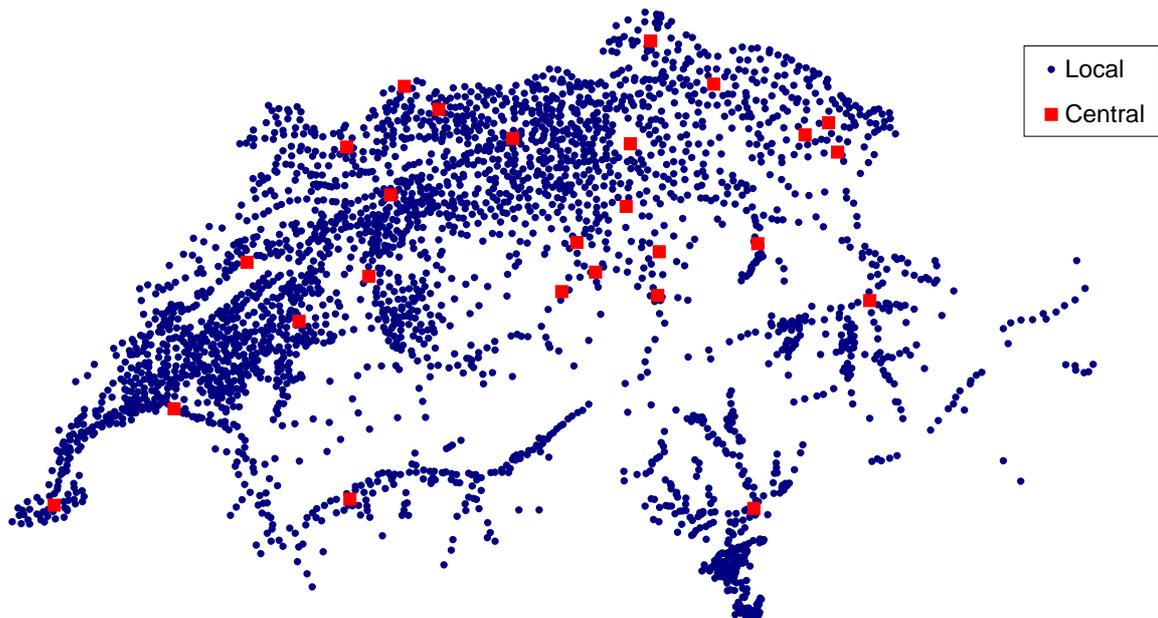
Table 1: Number of local counties and other characteristics by canton.

Canton	Number of local counties	Population in 1000s	Average population per local county	Average surface in km2 per county*	Degree of education expenditure decentralization**
Aargau	232	539	2325	5.91	0.37
Appenzell-Ausserrhoden	20	54	2688	11.98	0.78
Appenzell-Innerrhoden	6	15	2488	26.35	0.73
Basel-Stadt	3	190	63338	11.79	0.01
Basel-Landschaft	86	258	2996	5.98	0.63
Bern	400	942	2356	12.02	0.48
Fribourg	242	233	965	6.30	0.50
Genève	45	402	8938	5.37	0.15
Glarus	29	39	1334	14.95	0.68
Graubünden	212	186	878	19.55	0.76
Jura	83	69	831	10.02	0.45
Luzern	107	345	3224	13.01	0.71
Neuchâtel	62	166	2672	11.46	0.66
Nidwald	11	38	3416	18.97	0.89
Obwald	7	32	4586	56.99	0.93
Schaffhausen	34	74	2165	8.67	0.66
Schwytz	30	128	4250	24.22	0.79
Solothurn	126	243	1931	6.22	0.75
St. Gallen	90	447	4963	19.63	0.81
Ticino	245	308	1257	7.84	0.44
Thurgau	80	227	2832	10.64	0.77
Uri	20	36	1776	23.88	0.67
Vaud	384	615	1601	6.99	0.45
Valais	160	275	1719	15.07	0.40
Zug	11	97	8834	18.38	0.74
Zürich	171	1196	6996	9.53	0.64
Switzerland	2896	7185	2481	14.26	0.55 ***

Notes: Decentralization is defined as the ration between the sum of all local expenditure in a canton and the sum of all local plus cantonal expenditures. * Based on total surface per canton minus non-producuctive surface (lakes, rock, glaciers). The population data is based on an average between 1997 and 2001. ** calculated for average education exexpenditure between 1981 and 1999. ***Average decentralization rate for 1982 to 1999 defined as the sum of all local expenditures across cantons on public education as a share of all expenditure by local and cantonal governments across cantons. The unweighted average across cantons is 0.61.

Figure 2: Education Expenditure Decentralization in Swiss Cantons.
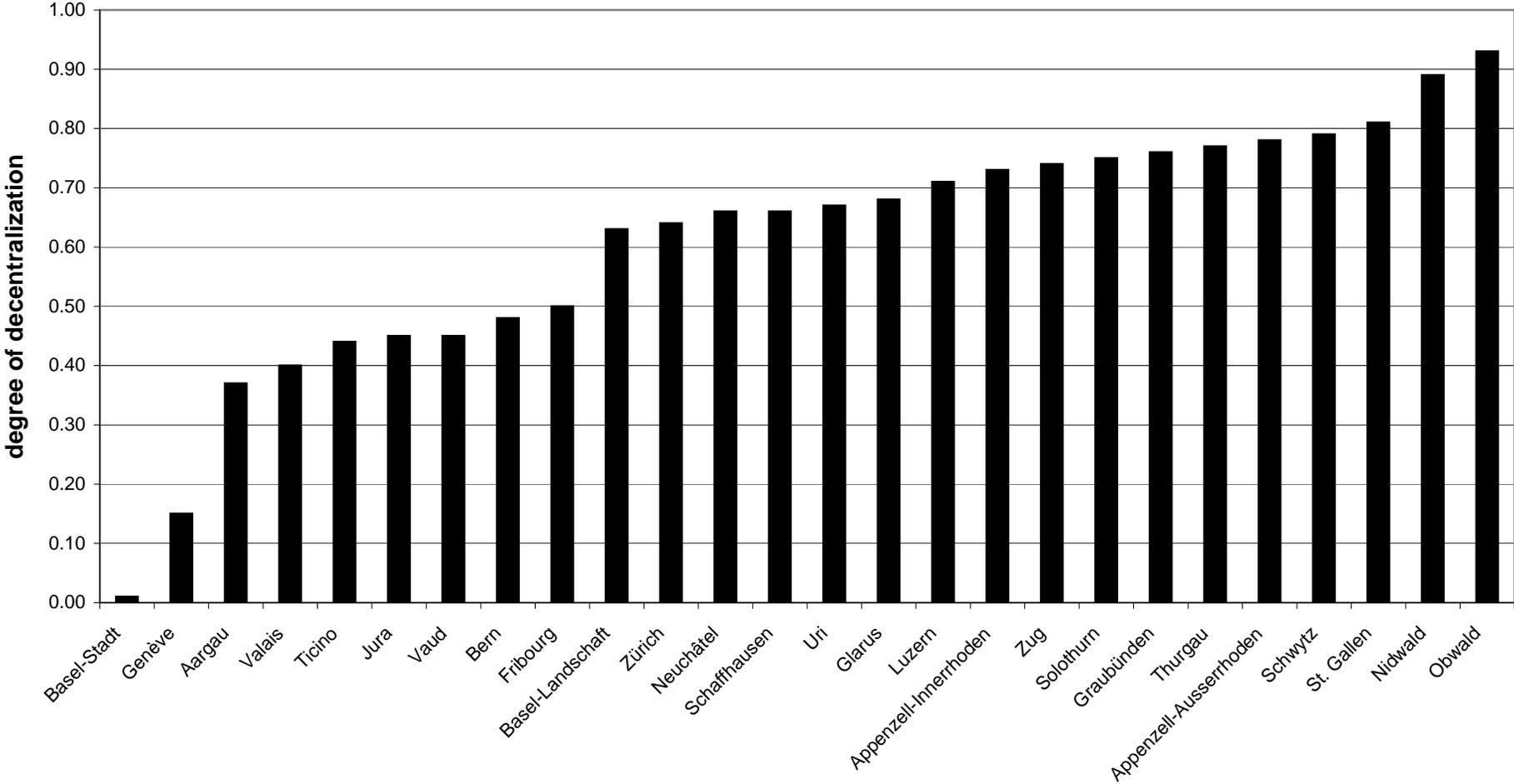
Figure 3: Education Expenditure in Swiss Cantons: 1982-1999
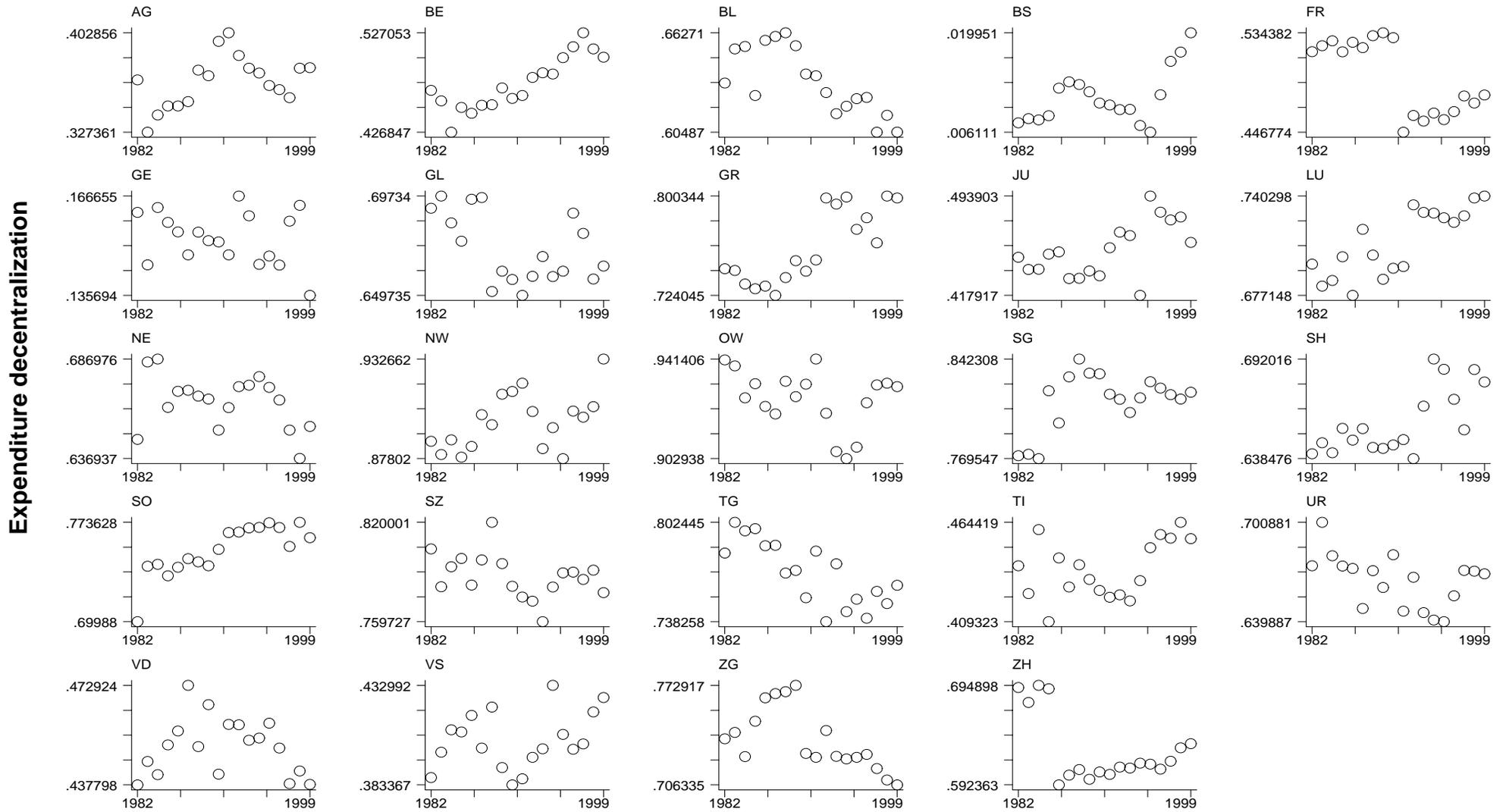
Table 2: Legal Sources on the local autonomy of schools in Swiss cantons as of 2003

Canton	Code	legal sources	Teacher appointment	Teacher Salary	Teacher Incentives	Structural School Organisation
Aargau	AG	http://www.ag.ch/sar/ 401.100 Schulgesetz	local art 42, Schulgesetz	central art 66 Schulgesetz	central	central Schulgesetz
Appenzell-Innerrhoden	AI	http://www.ai.ch/_d/lexdb/index.shtml 401.100 Schulgesetz	local art 42, Schulgesetz	central art 36, Schulgesetz	local art 44, 53b, 54; 401.1	central 401.1
Appenzell-Ausserrhoden	AR	www.ar.ch 411.0 Schulgesetz 411.1 Schulverordnung 412.21 Anstellungsverordnung Volksschule	local art 29, 411.0	central	local: art 10, 421.21 A local authority can spend up to 0.2% of their wage bill on bonus. Teachers can also remain on the same pay level or can be relegated to a lower pay level in case of unsatisfactory work.	local art 6, 411.1 (choice within Sekundarstufe 1)
Bern	BE	http://www.sta.be.ch/belex 432.210 Volkschulgesetz (VSG) 432.211 Volksschulverordnung (VSV) 430.250 Gesetz über die Anstellung der Lehrkräfte (LAG)	local art 7, 430.250	central 430.25	central except for reprimands: art 21 par. i, 432.211	central art 12, 432.210
Basel-Landschaft	BL	http://www.baselland.ch/ SGS 642.11 Schulordnung für die Volksschulen und IV-Sonderschulen SGS 640 Bildungsgesetz	local art 49 SGS 642.11 (by Schulpflege)	central	partially local Local administration can request further disciplinary measures going beyond formal reprimands: art 104 par 4; SGS 640.	central: art 24, SGS 640
Basel-Stadt	BS	http://www.gesetzessammlung.bs.ch Schulgesetz 410.100 Personalgesetz 162.100	partially local art 80,86,94; 410.100 local suggestion but decision central in particular if suggestion split in local authority.	central 162.100	central 162.100	central art 69; 410.100

Table 2 (continued)

Canton	Code	legal sources	Teacher appointment	Teacher Salary	Teacher Incentives	Structural School Organisation
Fribourg	FR	http://www.fr.ch 122.72.1 Gesetz über die Besoldungen des Staatspersonals 122.72.21 Beschluss über die Einreihung der Funktionen des Staatspersonals 411.0.1 Schulgesetz 411.0.11 Schulverordnung	local art 45; 411.0.1	central 122.72.21	central 122.72.1	central art 26 to 29; 411.0.1
Genève	GE	http://www.ge.ch C 1 10: Loi sur l'instruction publique	central by the Conseil d'Etat art 122, C 1 10	central C 1 10	central art 130, C 1 10	central C 1 10
Glarus	GL	http://www.gl.ch/gesetzessammlung/ IV B/1/3 Bildungsgesetz	local art 64, IV B/1/3 (Schulbehörde)	central: art 74, IV B 1/3	local art 67, IV B 1/3	central art 12-40; IV B/1/3
Graubünden	GR	www.gr.ch 421.000 (Schulgesetz) 170.400 (Personalverordnung, PV) 421.080 Lehrerbesoldungsverordnung	local: art 34; 421.000	central: art 35; 421.000	local: art 5; 421.080 art 14 par 4; 170.400 Pay increases on average by one step on pay scale per year but local authority can, depending on performance, award between zero and two steps.	central: 421.000
Jura	JU	www.ju.ch 410.11 Loi scolaire 173.11 Loi sur le statut des magistrats, fonctionnaires et employés de la République et Canton du Jura	local: art 87; 410.11	central (strict!): art 96; 410.11	central art 95; 410.11 art 30,31; 173.11	central 410.11

Table 2 (continued)

Canton	Code	legal sources	Teacher appointment	Teacher Salary	Teacher Incentives	Structural School Organisation
Luzern	LU	http://www.lu.ch SRL 400.a: Gesetz über die Volksschulbildung (GVSB) SRL051: Gesetz über das öffentlich-rechtliche Arbeitsverhältnis (Personalgesetz) SRL075: Besoldungsverordnung für die Lehrpersonen und die Fachpersonen der schulischen Dienste	local: art 47; SRL 400.a	central/part local art 29; SRL 400.a art 11; SRL 075 stipulates that up to 25% of salary can be paid to attract teachers with exceptional qualifications.	local art 48 GVSB, art 35; SRL400.a: up to 25% of salary can be given as a reward for extraordinary performance. art 11; SRL075: up to 25% of salary increase to keep a teacher with exceptional qualification. art 8 par 3; SRL075: if a teacher does not fulfill requirments than her pay can remain on the same level (instead of automatic increase to the next level)	central: SRL 400.a
Neuchâtel	NE	www.ne.ch RSN 410.10: Loi sur l'organisation scolaire RSN 410.23: Loi concernant les autorités scolaires RSN 152.510: Loi sur le statut de la fonction publique RSN 152.511: Règlement général d'application de la loi sur le statut de la fonction publique	local: art 32; 410.10 art 14; 410.23	central 152.510 152.511	part local (requires approval from central government): rewards for exceptional service art 61; 152.510 and art 36; 152.511	central 410.10

Table 2 (continued)

Canton	Code	legal sources	Teacher appointment	Teacher Salary	Teacher Incentives	Structural School Organisation
Nidwald	NW	www.nw.ch/regierung_verwaltung/staatskanzlei/kanzlei/druckzentrale/gesetzessammlung/band 3/inhalt_3.html 311.1 Bildungsgesetz 311.112 Vereinbarung über die Entlöhnung der Lehrpersonen der Gemeindeschulen (Entlöhnungsvereinbarung) 312.1 Volksschulgesetz	local art 20; 311.1	partially local art 21; 311.1 Local counties choose payment scheme by majority rule which has to be approved by central government. Central government can then implement scheme in all counties if a majority of counties approve of it.	local art 11 par 2; 311.112, no increase in pay due to insufficient performance art 7; 312.1 quality audit; in case of changes local recommendations are to be taken into account whenever possible	central 311.1
Obwald	OW	www.ow.ch 410.1 Gesetz über Schule und Bildung (Schulgesetz) 130.1 Staatsverwaltungsgesetz art45ff 141.111 Ausführungsbestimmungen über die Stellenbewertung und Entlöhnung 141.11 Personalverordnung	local: art 68; 410.1 art 73; 130.1	central art 23, 141.11	local: art 6 and 8 par d, 141.111 Punishments for insufficient performance leading to pay remaining on the same pay level or relegation to a lower level. Performance related pay of up to 60% above base.	central art 12; 410.1
St. Gallen	SG	www.gallex.ch SGS 213.1 Volkschulgesetz SGS 213.51 Gesetz über die Besoldung derVolksschullehrer	local art 114; 213.1	central SGS 213.51	part local local for end of contract, art 72; 213.1. central for stop of salary increase art 82, 86; 213.1	central 213.1
Schaffhausen	SH	www.sh.ch SHR 410.1 Schulgesetz SHR 180.100 Personalgesetz SHR 180.110 Besoldungsdekret	local art 57; 410.1	central art 79; 410.1 and art 2d; 180.110	central art. 9 and 41; 180.100	central 410.1

Table 2 (continued)

Canton	Code	legal sources	Teacher appointment	Teacher Salary	Teacher Incentives	Structural School Organisation
Solothurn	SO	www.so.ch 413.111 Volksschulgesetz (VSG) 413.121.1 Anstellungsverordnung Volksschule 126.515.851.1 Lehrerbesoldungsgesetz	local art 53; 413.111 and art 5; 413.121.1	central art 12; 413.121.1 and art ; 126.515.851.1	central: art 4 par. 2 in 126.515.851.11 art 4 par 2	local: art 21, par 2; 413.111: local counties can introduce an optional 10th year (nine years are compulsory)
Schwytz	SZ	www.sz.ch 611.210 Verordnung ü.d. Volksschule 612.110 Personal- und Besoldungs-verordnung für die Lehrpersonen an der Volksschule	local art 5; 612.110	central 612.110	local art 41; 612.110: school council can allocate up to 0.3% of total wage bill to bonus payments for exceptional performance.	central 611.210
Thurgau	TG	www.tg.ch 410.1 Unterrichtsgesetz 177.22 Besoldungsverordnung 177.250 Verordnung des Grossen Rates ü.d. Besoldung der Lehrkräfte	part central: art 54; 410.1 (nominated locally but approved centrally)	central: 177.250	local up to 5% wage reduction for poor performance art 12; 177.22, but strictly no additional payments by local authorities art 6, (177.250)	central 410.1
Ticino	TI	www.ti.ch 5.1.6.1.1: R della scuola media 5.1.1.1: L della scuola 2.5.4.1 Legge sull' ordinamento degli impiegati dello Stato e dei docenti	local art 2 par b; 2.5.4.1.	central 2.5.4.1.	central 5.1.6.1.1 and art 34; 2.5.4.1	central 5.1.1.1
Uri	UR	http://www.ur.ch/rechtsbuch/start.htm 10.1111 Schulgesetz 2.4211 Personalverordnung	local art 59; 10.1111	part local art 55; 10.1111: The local authorities regulate public employment within the framwork of cantonal law.	local: a) pay increase is based on satisfactory performance: art 40 par 4; 2.4211. b) concerning bonus payment for excellence in performance art 41 and 42; 2.4211	central 10.1111

Table 2 (continued)

Canton	Code	legal sources	Teacher appointment	Teacher Salary	Teacher Incentives	Structural School Organisation
Vaud	VD	www.vd.ch RSV 4.2.A Loi Scolaire RSV 1.6. A Loi sur le personnel de l'Etat de Vaud (LPers)	local art. 79, 4.2.A	central RSV 1.6	central art 27; RSV 1.6	central 4.2.A
Valais	VS	www.vs.ch 400.1 Loi sur l'instruction publique 405.3 Loi concernant le traitement du personnel enseignant des écoles primaires, du cycle d'orientation et des écoles secondaires du deuxième degré.	local art 75; 400.1	central	central art 98, 400.1	local art 50; 400.1 a) Pupils of different school years can be regrouped into one class for effectiveness. b) Local counties can introduce an optional tenth school year.
Zug	ZG	www.zg.ch 412.11 Schulgesetz 412.31 Lehrerbesoldungsgesetz 154.21 Personalgesetz	local art 61; 412.11	local art 6, abs. 9-11; 412.31 to attract teachers, pay can be increased by up to 25%.	local art 6 abs 7, 9, 12; 412.31. art 74 abs 1 lit c 154.21: Bonus for exceptional performance and valuable proposals.	central art 65; 412.11
Zürich	ZH	www.zhlex.ch 412.11 Volksschulgesetz 177.1 Personalgesetz 412.31 Lehrerpersonalgesetz 412.311 Lehrerpersonalverordnung	local art 7, 412.31	central 412.311	local art 23 and 24; 412.311 Increase in teachers pay based on "good" evaluation score.	local art 55; 412.11 Local counties can choose between two school models for lower secondary school.

Table 3: Cantons ranked by level of education decentralization and their scope of local autonomy

canton	education decentralization	teacher appointment	teacher salary	teacher incentives*	structural school organisation**
Obwald	0.93	x		x	
Nidwald	0.89	x	(x)	x	
St. Gallen	0.81	x		(x)	
Schwytz	0.79	x		x	
Appenzell-Ausserrhoden	0.78	x		x	x
Thurgau	0.77	(x)		x	
Graubünden	0.76	x		x	
Solothurn	0.75	x			x
Zug	0.74	x	x	x	
Appenzell-Innerrhoden	0.73	x		x	
Luzern	0.71	x	(x)	x	
Glarus	0.68	x		x	
Uri	0.67	x	(x)	x	
Neuchâtel	0.66	x		(x)	
Schaffhausen	0.66	x			
Zürich	0.64	x		x	x
Basel-Landschaft	0.63	x		(x)	
Fribourg	0.50	x			
Bern	0.48	x			
Jura	0.45	x			
Vaud	0.45	x			
Ticino	0.44	x			
Valais	0.40	x			x
Aargau	0.37	x			
Genève	0.15				
Basel-Stadt	0.01	(x)			

Note: Education decentralization is defined as the sum of all local expenditure devided by cantonal expenditure plus the sum of all local dependiture in a canton. x: the decision is taken at the local and not at the central level. (x): decision is shared between local and central government. * Local authorities take the decision about performance related pay (pay level increment, bonus). ** Local authorities can take decision about significant organisational matters (class structure, schemes). See Appendix 1 and Table 2 for legal sources and further information.

Table 4 – Summary Statistics

All data is converted to natural logarithm*
The Date covers 26 Swiss Cantons during 1982-2000
Standard errors in parentheses

Performance Measure for Public Education

Maturité rate (in logs) **share of 19 year population with University entry level qualification**	**.151** **(.048)**
Female Maturité rate as a share of 19 year old women (in logs)	**.151** **(.062)**
Male Maturité rate as a share of 19 year old men (in logs)	**.149** **(.040)**
Professional School Degrees as a share of 19 year old population (in logs)	**.462** **(.087)**

Decentralization

Share of local expenditure to all expenditure (local and central, in logs) *5 year moving average*	**.466** **(.147)**

Control Variables

Education expenditure per pupil (12 year moving average, in logs)** **at all levels of government in 1990 Swiss Francs**	**2.712** **(.1805)**
Class size in schools (12 year moving average, in logs)	**3.478** **(.1045)**
Non-native speakers (12 year moving average, in logs) **percent of students whose first language is not the language of instruction**	**2.672** **(.5000)**
Budget surplus as a percent of cantonal GDP (5 year moving average, in logs) **-at the central (cantonal) government level**	**-.0007825** **(.0009249)**
-at the local government level	**-.0003655** **(.0003825)**
Number of local jurisdictions in a canton	**111.38** **(111.74)**

Notes: Source is Swiss Federal Statistical Office (various departments); http://www.statistik.admin.ch *All data converted to natural logarithms unless for proportions when converted to log(x+1). *primary and secondary education excluding tertiary education.

Table 5 – Decentralization and Educational Attainment in Swiss Cantons

Dependent variable = Share of 19 year old population obtaining university entry qualification (Maturité rate)
Robust standard errors reported in parentheses, allowing for clustering at canton level

	Base regression	Canton & year effects	Further controls	Further controls	Effect over time
	(1)	(2)	(3)	(4)	(5)
Decentralization *average of past 12 years*	-0.2146*** (.0607)	0.3767* (.2185)	0.4085* (.2323)	0.4123* (.2133)	
Decentralization *average of past 5 years*					0.3749** (.1740)
Decentralization *average of 6 to 12 years lagged*					0.0811 (.1003)
Expenditure per pupil *average of past 12 years*			0.0842 (.0537)	0.0937* (.0483)	0.0994** (.0450)
Class size in upper secondary school *average of past 12 years*			-0.0288 (.0580)		
Non-native speakers *average of past 12 years*			0.0105 (.0236)		
Canton fixed effects	No	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	Yes	Yes
Errors clustered at canton level	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.4246	0.9516	0.9539	0.9536	0.9544
Number of observations	208	208	208	208	208

Notes: * significant at 10% level, ** at 5% level, *** at 1% level. See Table 4 for definition of variables. Right hand side variables in column (1)-(4) are average values of past 12 years. In column 5 decentralization is split into average of past 5 years - proxying for the period during upper secondary school - and 6 to 12 years in the past - proxying for the period during primary and lower secondary school.

Table 6 – Instrumental Variable Regression

First stage regression Dependent variable = Decentralization rate
Robust standard errors reported in parentheses, allowing for clustering at canton level

Urbanization *average of past 5 years*	0.5269*** (0.1613)
Expenditure per pupil *average of past 12 years*	0.0093 (0.01913)
Canton fixed effects	Yes
Year fixed effects	Yes
Errors clustered at canton level	Yes
Adjusted R-squared	0.9988
Number of observations	176

Second stage regression Dependent variable = Maturité rate
Robust standard errors reported in parentheses, allowing for clustering at canton level

Decentralization *average of past 5 years*	1.5644** (0.6178)
Expenditure per pupil *average of past 12 years*	0.1426** (0.0548)
Canton fixed effects	Yes
Year fixed effects	Yes
Errors clustered at canton level	Yes
Adjusted R-squared	0.9434
Number of observations	176

Notes: * significant at 10% level, ** at 5% level, *** at 1% level. Urbanization is the log of the share of the population in a canton living in urban areas.

Table 7 – Decentralization, Economies of Scale, Local Autonomy, and Budgetary Competence

Dependent variable = Share of 19 year old population obtaining university entry qualification (Maturité rate)
Robust standard errors reported in parentheses, allowing for clustering at canton level

	Economies of Scale (1)	Local Autonomy (2)	Budgetary Competence (3)
Decentralization *average of past 5 years*	0.6619** (.2547)	1.164** (.5566)	0.6554** (.2705)
Decentralization x Number of local jurisdictions *average of past 5 years*	-0.00199** (.00088)	-0.0035** (.00172)	-0.00180* (.0010)
Decentralization x Dummy =1 when teacher incentives decided at local level *average of past 5 years*		-0.6345 (0.5147)	
Decentralization x Budget Surplus at the local level *average of past 5 years*			15.827* (9.058)
Decentralization x Budget Surplus at the cantonal level *average of past 5 years*			-.4589 (4.235)
Expenditure per pupil *average of past 12 years*	0.1080** (.0427)	0.1022** (.0425)	0.0993** (.0424)
Canton fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Errors clustered at canton level	Yes	Yes	Yes
Adjusted R-squared	0.9554	0.9561	0.9564
Number of observations	208	208	208

Notes: * significant at 10% level, ** at 5% level, *** at 1% levell. See Table 4 for definition of variables. Right hand side variables in column (1)-(4) are average values of past 12 years. In column 5 decentralization is split into average of past 5 years - proxying for the period during upper secondary school - and 6 to 12 years in the past - proxying for the period during primary and lower secondary school.

Table 8 – Any Adverse Effects of Decentralization?

Robust standard errors reported in parentheses, allowing for clustering at canton level

	Dependent Variable: Maturite rate among women (1)	Dependent Variable: Maturite rate among men (2)	Dependent Variable: Professional school degrees (3)
Decentralization *average of past 5 years*	0.6806 (.4975)	0.8325*** (.2911)	-1.061 (1.064)
Decentralization x Number of local jurisdictions *average of past 5 years*	-0.0017 (.1935)	-0.0026* (.0015)	0.0045 (.0047)
Decentralization x Budget Surplus at the local level *average of past 5 years*	0.1935 (12.652)	38.874** (16.582)	-43.442 (104.28)
Decentralization x Budget Surplus at the cantonal level *average of past 5 years*	-1.2598 (5.4159)	-8.789 (7.295)	52.53** (25.084)
Expenditure per pupil *average of past 12 years*	0.1778** (.0656)	-0.0075 (.0869)	-.1248 (.3957)
Canton fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Errors clustered at canton level	Yes	Yes	Yes
Adjusted R-squared	0.9483	0.9561	0.7313
Number of observations	182	182	208

Notes: * significant at 10% level, ** at 5% level, *** at 1% level. See Table 4 for definition of variables. The dependent variables are: in column (1) the number of women obtaining the maturite degree as a share of 19 year old women; in column (2) the number of men obtaining the maturite degree as a share of 19 year old men; in column (3) the number of students obtaining the professional school degree as a share of 19 year old population.