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Valtion taloudellinen tutkimuskeskus
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Abstract

We study the effects of intergovernmental grants on school spending within the Finnish system of high school education funding. The system allocates lump-sum intergovernmental grants to local education organizers using a kinked grant rule. Utilizing the quasi-experimental variation in grants given by the rule, we identify the effects of grants on municipal high school education expenditures. Our results indicate that grants stimulate spending while local tax rates or revenues do not seem to be responsive to grants, thus suggesting the presence of a typical flypaper effect. However, we also consider the possibility that grant responses might be heterogeneous among municipalities. Based on our heterogeneity results, the grant response is positively associated with the share of high school age population, while the higher share of elderly is related to a lower propensity to spend on education out of grant funding. This result is in line with the idea of intergenerational conflict in education spending preferences often presented in education finance literature.

Key words: intergovernmental transfers, flypaper effect, heterogeneous spending preferences, regression kink design

JEL classes: I22, H75, H73

1. Introduction

The effect of intergovernmental transfers on local government spending is a widely studied topic in public finance (see e.g. Hines & Thaler, 1995; Gamkhar & Shah, 2007; Inman, 2008 for reviews). Most of the debate concerns whether state grants crowd-in (stimulate) or crowd-out local spending (see e.g. Payne, 2009).[1] According to the standard median voter theory, transfers to the lower tiers of government should have a similar effect to local spending than equally sized increases in the local incomes. However, empirical studies have generally found that the effect of grants on spending is significantly larger than the effect of local incomes. This phenomenon has been dubbed as *the flypaper effect* since the grant money sticks for spending and does not translate into tax cuts for local residents.

Plenty of research has also examined the effects of education grants to the local education spending (see e.g. Fisher & Papke, 2000 for a review of earlier literature). The challenge however has been that grants are typically endogeneous in spending equations and earlier literature could not address this problem convincingly. As a consequence, more recent empirical analyses of education funding have adopted quasi-experimental identification strategies utilizing school finance reforms or funding formulas in order to identify the causal effects of grants on local spending (see e.g. Hoxby, 2001; Guryan, 2001; Card & Payne, 2002; Gordon, 2004; Baicker & Gordon, 2006; Cascio et al., 2013). It is worth noting that in many countries education funding is arranged through formula-based funding rules, which might enable the utilization of such quasi-experimental methods (see e.g. European Commission, 2014). This is the case also in Finland in terms of its high school (or general upper secondary school) funding, while there is no corresponding rule in other layers of education system. Yet, to our knowledge, there are no previous quasi-experimental or even descriptive studies looking at the relationship between education grants and local education spending in the context of

[1] We use the terms 'transfer' and 'grant' interchangeably in this paper.

Finnish high schools.[2] Thus, there is a dire need for Finnish evidence on the effects of grants on school expenditure based on credible identification strategy utilized in the recent literature.

Despite the abundance of flypaper research, heterogeneous grant responses have received less attention. Especially the age structure of localities has not been considered as the leading candidate to explain the effect heterogeneity.[3] However, beyond the realm of flypaper literature, there is a plethora of research owing much to Poterba (1996, 1998) studying variations in local preferences towards public education spending due to demographic composition of localities. Generally the empirical consensus has supported the intergenerational conflict hypothesis, which posits that a larger share of elderly population significantly decreases the support for education expenditures (see e.g. Brunner & Johnson, 2016; de Mello et al., 2016; Cattaneo & Wolter, 2009; Reback, 2015; Figlio & Fletcher, 2012; Fletcher & Kenny, 2008; Brunner & Baldson, 2004). Nevertheless, to our knowledge, there has been surprisingly little overlap between the intergenerational conflict and intergovernmental transfer literatures, as only few studies consider preference heterogeneity due the demographics in the education grant context. For example Mattos et al. (2017), Cascio et al. (2013), and Ahlin and Mörk (2008) all do examine education grant effect heterogeneity, but none of them consider age structure as a driver of this heterogeneity. In Baicker and Gordon (2006) and Dahlberg et al. (2008) on the other hand, age structure heterogeneity is only cursorily examined.

This study is one step forward to fill the abovementioned gaps in the literature. Our contribution is twofold. First, we explore the heterogeneity among Finnish municipalities in their high school grant responses utilizing a quasi-experimental research design. In the Finnish system, high school funding is based on a formula funding rule where the unit price of a single

[2] In the Finnish context, only Lundqvist (2015) has examined the effects of general intergovernmental grants using a more convincing quasi-experimental research design. However, she does not consider high school education funding and she also utilizes different identification strategy (differences-in-differences).

[3] Some other suggested mechanisms behind heterogeneous responses include: voter information (Strumpf, 1998), interest groups (Singhal, 2008), democratic responsiveness of local government and income levels of municipality (Lutz, 2010), local ability to offset grants through taxation (Cascio et al., 2013), budgetary constraints (Brooks & Phillips, 2008), property ownership (Rockoff, 2010), distortionary taxation (Vegh & Vuletin, 2016), and local fiscal conditions (Ando, 2015a).

student for smaller high school organizers is increased in a piece-wise linear manner. As this piece-wise linear pricing rule is kinked at certain student thresholds, this allows us to utilize the regression kink design popularized and formalized by Card et al. (2015b). Since the main identification assumptions seem to hold at the threshold we focus on, the variation in grants can be considered random near the threshold. This exogenous variation enables us to infer the causal effect of unconditional high school grants on local high school expenditures. Second, we add to the very narrow empirical literature on Finnish intergovernmental grants. The scarce existing literature is outdated in the sense that they examine grant systems which were in place during the 1990s using only descriptive methods (see Oulasvirta, 1997; Moisio, 2002). Instead we focus to the part of the grant system that has been in place for a relatively long time and is still in use. The more recent addition to the literature by Lundqvist (2015) significantly improves the empirical methods compared to earlier studies, but she also deals a period of time from which the general grant system has been reformed since. Moreover, Lundqvist mainly studies local spending as a whole and we on the other hand focus on high school sector. Thus we can consider heterogeneity in spending preferences within this sector in more detail and are able to provide a somewhat more nuanced view of possible mechanisms behind the possibly heterogeneous high school grant responses. Our main results indicate the presence of flypaper effect and it seems that in municipalities with larger share of elderly population, high school spending responds less to education grants suggesting that there is indeed demographic heterogeneity in this effect.

This paper is organized as follows. In section 2 we summarize the main aspects of the Finnish high school funding system. In section 3 we describe the research design and identification strategy which the funding system gives rise to. The data and the validity of our research design are examined in section 4. The estimation results concerning the flypaper effect are presented in section 5. Section 6 focuses to the heterogeneous effects of grants. Section 7 concludes. Note that throughout the text we will refer to appendix material for additional details. We will denote the different sections of this material as AP-1, AP-2, and so forth.

2. The Finnish high school system and funding

2.1. High school education in Finland and the funding system

In Finland, basic compulsory education consist grades 1-6 (primary school) and grades 7-9 (middle school), after which students generally progress to upper secondary schooling. In this paper, we will concentrate on the academic track of upper secondary school, which we will, for brevity, refer as high school. The funding system we investigate concerns only high schools (or academic track of upper secondary school), while vocational upper secondary schools have different funding system. Typically municipalities organize high school education but also private institutions, municipality co-operatives and university practice schools offer high school education.[4] Larger municipalities generally have multiple high schools. Since the funding mechanism applies to organizers, not to the individual schools, it is important to differentiate between the two.

The funding of local public services is divided between the state and the local governments. The local financing of services is mainly based on a flat rate municipal income tax set by the municipalities themselves. For high school education, state allocates transfers distributed by the Ministry of Education and Culture. In accounting sense these high school transfers are distributed separately from a larger transfer system maintained by the Ministry of Finance, where the state funds the provision of other core public services such as basic education and healthcare. Importantly the high school grant is not tied to any specific purpose,

[4] Practice schools offer teaching orientation for university students studying to become a teacher. Since their funding is part of the university budget, not part of municipal funding decisions, we exclude these schools from our analysis. Also municipality co-operatives are excluded since their decision making is beyond any single municipality. While private institutions are within the same funding system as municipal high schools, we exclude also them from the analysis as they are fully funded by the state transfers and have no equivalent source of own funding as municipals have in local taxes as private institutions cannot collect any tuition fees.

even though it is nominally labelled and distributed as a high school grant. Consequently municipal organizers have also the possibility to divert the state transfers to other uses.

The level of high school grant is mainly determined by the number of students each organizer have in the beginning of a school year. A naïve implementation of fixed reimbursement per student would however place organizers of different size in a rather unequal position in terms of funding. The size of the pool of student seeking admittance to high schools across areas varies greatly because Finland is characterized with very unevenly distributed population among urban centers and rural areas. Moreover prospective students are free to choose any school they wish. Thus the larger selection of schools in urban areas may further reduce the size of student pool for rural schools. This limits the possible economies of scale from which smaller organizers is able to benefit. All organizers must however meet certain national curricula criteria and offer the basic student services (e.g. lunches and school health care) regardless of their size. Consequently smaller organizers cannot respond to a smaller student pool by cutting back the level of teaching and services they offer. Thus the expenditures per student are higher for smaller organizers. The funding system attempts to account for this by providing more funding to smaller organizers, as described in the next section.

2.2 The funding system and grant formula

The funding given to the high school organizers is based is a product of the number of students and the organizer specific unit price of a single student, defined as in Equation (1).

$$p_{it} = \frac{M_{it} \times N \times p_a}{100} = \frac{(100 + m_{it}) \times N \times p_a}{100} \tag{1}$$

In Equation 1, p_{it} is the unit price for organizer *i* in year *t*. The first component of it, p_a, is the national average unit price based on actual realized costs of some predetermined range of previous year(s) and it is set by the Finnish National Board of Education. Certain budgetary, legislative and index corrections may be applied when setting this average price.[5] N is a national multiplier that smooths out the mechanic changes in the average price p_a due to the changes in organizer specific prices. Since both p_a and N are constant across all organizers, they are of little consequence for our analysis and we omit the further details of them. The variation in unit price is caused by the multiplier M_{it} given in Equations 2 and 3, where s_{t-1} is the number of students observed in the fall of year *t-1* (the start of academic year). The multiplier visualized in Fig. 1. Currently the limit of 200 students is used as the critical threshold below which increments to unit price apply. This system of incremental funding has been in place from year 1999 onwards. Any official documents did not reveal the origins of this limit but we assume that it has been set relatively arbitrarily as a result of political negotiations. It is however worthwhile to note that high schools in Finland most commonly are in the size range of 100-299.[6] This might have partly directed the choice of the threshold. There is also another threshold at 60 students which entitles institutions for even higher multiplier, with a cap at 40 students.

$$M_{it} = 100 + m_{it} \tag{2}$$

$$m_{it} = \begin{cases} 0 & \text{if } s_{i,t-1} \geq 200 \\ 0.4 \times (200 - s_{i,t-1}) & \text{if } 60 \leq s_{i,t-1} < 200 \\ 0.4 \times (200 - s_{i,t-1}) + 2.1 \times (60 - s_{i,t-1}) & \text{if } 40 \leq s_{i,t-1} < 60 \\ 106 & \text{if } s_{i,t-1} < 40 \end{cases} \tag{3}$$

[5] For the year 2016 the average price was set at 6122.06 €/student.

[6] In 1999 and 2000, around 48% of the high schools fell to this range. While the share has declined over the years, 100-299 school size is still the most common. Source: http://www.oph.fi/julkaisut/2003/indikaattorit_2003 (Report of National Board of Education, 2003).

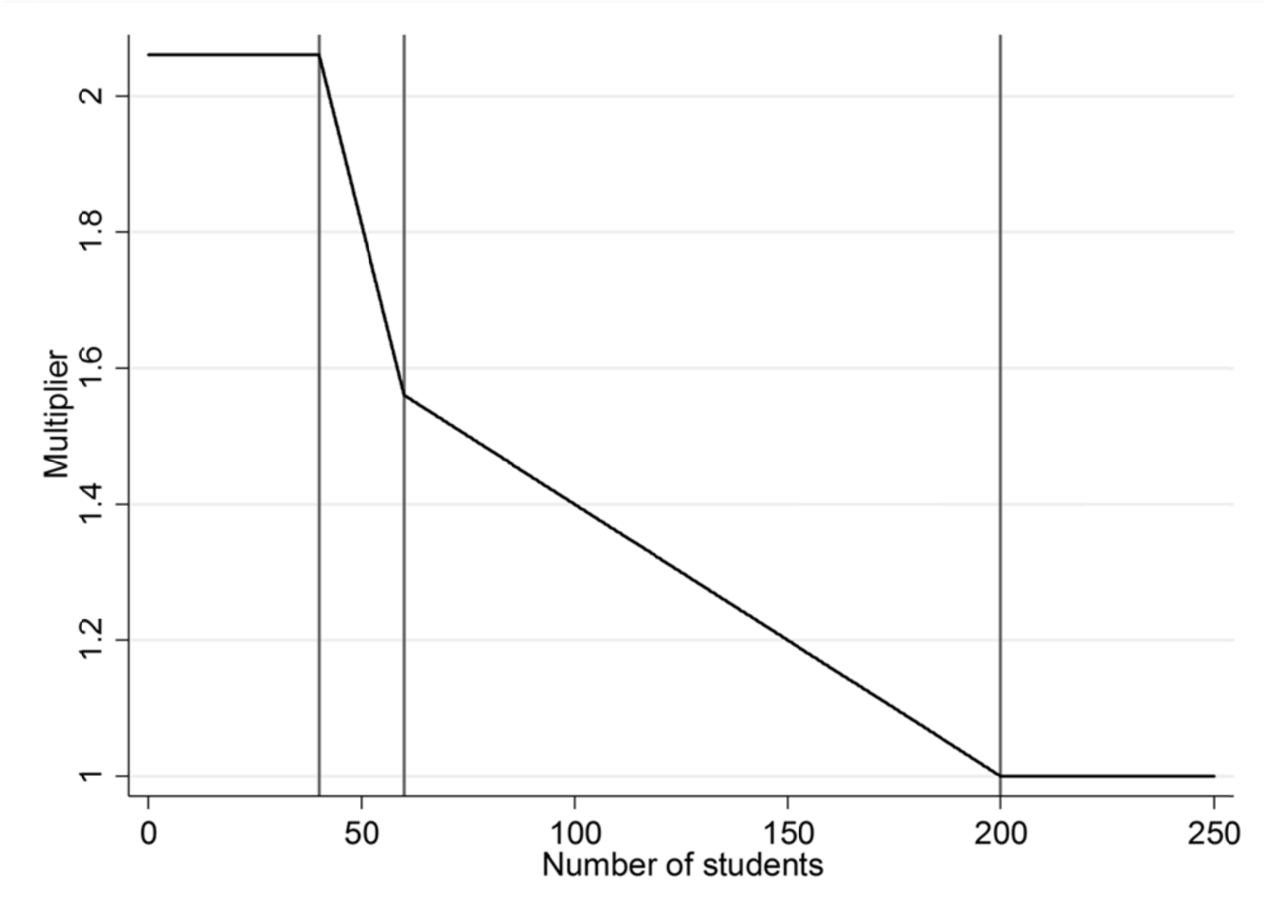

Fig. 1 The organizer specific unit price multiplier (divided by 100)

Fig. 2 illustrates the timeline of grant process using the year 2013 as an example. The number of students in year *t-1* sets the unit price multiplier for the year *t* since academic and accounting (fiscal) years do not match (Stage A). Whereas the former runs from the fall of year *t-1* to the spring of year *t*, the accounting year is defined as a calendar year. The number of students is still subject to a fiscal year adjustment (stages B, C, D1, & D2), but our identification strategy is based on the initial multiplier set at the beginning of academic year. The grant is paid in equally sized monthly instalments, but it can be viewed as a lump sum grant, since except for the fiscal year adjustments, organizers know the total grant for the year 2013 at the fall of 2012.

Fig. 2 The timeline of grant process for 2013 grant. *Note:* Stage A**:** The initial unit price and the grant for year 2013 is based to the student number of last fall which is recorded on 20.9.2012. Thus organizers know the initial funding for the year 2013 at this stage. Note however that the funding is paid in 12 monthly pieces during the year 2013. Stages B&C: The number of students is measured again on 20.1.2013 and 20.9.2013. Based on a weighted average of these two (weights 7/12 & 5/12), the grant is adjusted to correspond the student number of the budgetary year (2013) at the end of 2013 (stage D1). The adjusted number of students applies only to the amount of grant, not to the determination of the multiplier, which is solely based on the number of students on previous fall. Stage D2: The adjustment of the year (2013) is paid around Feb 2014, but so that it is still included to the financial statements of the year 2013.

3. Identification and empirical estimation

The kinked grant formula gives rise to an identification strategy utilizing regression kink design (RKD) formalized by Card et al. (2016; 2015b; see also Nielsen et al., 2010). Regression kink design is a close relative of the popular regression discontinuity design (RDD) but instead of discontinuities in levels, RKD utilizes slope changes in identification.[7] Following Card et al. (2015b) and Nielsen et al. (2010), the RKD strategy can be described more formally as in Equation 4, where Y is the local expenditure per student and B is the amount of state grant per student. $g(.)$ is some smooth function of the number of students (previous fall) S, which is our forcing variable, and ε is the typical error term. The parameter of interest is τ, which corresponds to the effect on grants on local spending. Since we assume that the formula

[7] RKD has been applied to study the effects of the replacement rate of a social (sickness) insurance system on sickness absence from work (Böckerman et al., 2015), unemployment insurance benefit on future labor market outcomes (Card et al. 2015a; Kyyrä & Pesola, 2016), student aid on college enrollment (Nielsen et al., 2010), and intergovernmental grants on local employment, spending, and tax rates (Baskaran, 2016; Ando, 2015a; Lundqvist et al., 2014; Dahlberg et al., 2008).

thresholds are exogenous, the variation in grants near the threshold can be considered as good as random. Note that our design is a fuzzy design, due to the fiscal year adjustment and some discretionary components in the unit price which account for extra expenditures needs due to special tasks (e.g. placing emphasis on some fields such as sports or math/science) or multi-language teaching.

$$Y = \tau B + g(S) + \varepsilon \quad (4)$$

$$Y_{it} = \beta_0 + \beta_1 \hat{B}_{it} + \sum_{p=1}^{p*} \gamma_p [S_{it} - s_0]^p + \varepsilon_{it} \quad (5)$$

$$B_{it} = \alpha_0 + \alpha_1 (Z * [S_{it} - s_0]) + \sum_{p=2}^{p*} \alpha_p Z * [S_{it} - s_0]^p + \sum_{p=1}^{p*} \delta_p [S_{it} - s_0]^p + \eta_{it} \quad (6)$$

The estimation of τ generally applies local linear regression on both sides of the threshold using a bandwidth (*h)* of observations around the threshold. We take an agnostic view and alternate the bandwidth over a wide range of values. We use uniform kernel, thus effectively translating the estimation into a standard IV-estimator shown in Equations 5 and 6, where $[S_{it} - s_0]$ is the number of students centered around the kink point (s_0) and $Z = \boldsymbol{I}[S_{it} \geq s_0]$. Their interaction term (and the possible higher order terms of it) is the excluded instrument. Initially we use several different polynomial orders (*p*) for the control function $g(.)$, but for reasons stated later, we will focus to the first order specification. The key identifying assumption after controlling for this smooth relationship (control function) is that any kinked relationship between the expenditures and number of students is due to the kinked grant formula. This requires that both the density of the running variable and all other covariates evolve smoothly through the kink point.[8] Thus the point estimate of interest should not change much when additional covariates are included if the design is valid.

[8] To be accurate, RKD requires that the density of the running variable is continuously differentiable at the kink point, which implies the derivative of the density at the kink point is continuous.

4. Data and the validity of design

4.1 Data

Original dataset is an unbalanced panel of all high school education organizers from years 2001-2014 but we focus only to municipal organizers.[9] We use the municipal division of each corresponding year in order to include also organizers that do not exist anymore in 2014. We have data on total high school expenditures, grants (both per student), and the number of students, obtained from the National Board of Education funding data repository. The funding data is merged with the data on municipal level characteristics, which is obtained from Statistics Finland. This data includes data on the number of high schools, municipal tax rates and tax revenues, other state transfers, the average income level of residents, demographic data (years 2003-2014 only)[10], expenses on social and healthcare costs (SOHC) and political variables related to municipal elections. All data is publicly available on the webpages of abovementioned data providers.[11]

Unfortunately we cannot attribute expenditures to single schools when organizer has many schools since the funding data is at the organizer level. In such cases the observed expenditures do not necessarily reflect actual spending behavior of any individual school as there can be large within organizer expenditure differences between schools. Thus we focus on municipal organizers with one school. This restriction results in total of 2904 observations in the raw sample. We however do check whether our results are affected if we include organizers with multiple schools (see Häkkinen et al., 2003). Note that not many such organizers are under the influence of formula as they are generally much larger than 200 students.

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[9]From the total 323 organizers observed at any point of time, there are 32 private organizers and 286 municipal organizers. The remaining 5 institutions are run by joint municipal organizers. University practice high schools are not included in the funding data at all as they are not within the same funding system.

[10] In order to increase the sample size, our estimations use versions of the demographic variables where missing values in years 2001-2002 have been replace with the year 2003 values. The demographic composition of the municipality is anyhow unlikely to change much within in timespan of few years. The main results using our preferred specification in Section 5 are very similar if we restrict our estimation sample to cover only years 2003-2014.

[11] See further details from the data description appendix AP9 and the following webpages: National Board of Education funding data repository: https://vos.oph.fi/rap/ ; Statistics Finland: http://stat.fi/

The summary statistics are shown in Table 1. All the monetary variables have been deflated to 2014 euros. The size of organizers varies from two students to over a thousand (additional summary statistics in AP1). On average the observed expenditures per student are about 1017 euros higher than the grants (difference variable), implying that organizers would supplement the grant with their own funding. For some organizers the difference is however negative, indicating that these organizers divert the grant money elsewhere. In AP2 we conduct a correlation analysis among some of our key variables to provide additional insights on how municipal characteristics move together.

Table 1 Summary statistics of key variables (over years 2001-2014; demographic data 2003-2014)

Variable	N	Mean	SD	Median	Min	Max
High school education costs, €/student	2904	8347.05	3309.97	7705.27	4569.58	71814.11
Grant €/student	2904	7330.57	2167.37	6936.30	4932.48	29956.80
Cost vs. Grant difference, €/student	2904	1016.51	1968.99	819.05	-2899.11	53526.92
Students (previous fall)	2904	170.64	126.62	138.00	2.00	1014.00
SOHC net costs €/resident[a]	2904	3338.90	537.51	3260.18	2208.30	5679.00
Tax income €/resident	2904	3030.92	446.21	2964.51	2080.68	7144.98
Population	2416	8887.49	6865.03	6837.00	1063.00	40390.00
0-14 year olds, share of total	2416	0.17	0.04	0.16	0.09	0.35
15-19 year olds, share of total	2416	0.06	0.01	0.06	0.03	0.10
20-24 year olds, share of total	2416	0.04	0.01	0.04	0.02	0.09
Over 65 year olds, share of total	2416	0.21	0.05	0.21	0.06	0.40
Municipal election vote turnout[b]	598	63.24	5.25	62.70	42.00	84.90
Municipal loan stock, €/resident	2843	1843.72	1091.98	1735.40	1.13	6444.00
Municipal income tax rate	2904	19.21	0.93	19.00	16.00	22.50
Size of local council[b]	596	30.54	8.26	27.00	15.00	75.00
Taxable income, t-1, €/resident	2894	12637.04	2125.82	12253.87	8063.38	27553.40
Other state transfers, €/resident	2904	2278.06	849.69	2280.27	222.90	5416.00
Municipal staff (per 1000 residents)	2900	62.04	15.50	61.00	4.00	133.00

Note: Municipal organizers with one school included. SOHC net costs are the difference between the gross operating cost and operating income. Note also that municipal elections are held every four years. In our data they occur at 2004, 2008 and 2012. In the actual estimations we use versions of the variables such that all year within single electoral cycle gets the values observed on the years of last elections.

4.2 Validity of the research design

First we check the distribution of running variable. In Fig. 3 we plot its distribution of bin means of frequencies with the bin width of 2 for organizers with less than 500 students. The distribution runs smoothly through the thresholds of 40 and 200 students but in the former case there are relatively few observations for a meaningful analysis. At the threshold of 60 the distribution has a jump, thus casting a doubt whether the design is valid at this point.[12] The formal statistical tests of smoothness can found in AP3. These tests indicate that concentrating on the threshold of 200 is warranted.

Despite the formal tests indicate a smooth density at the 200 threshold one may argue that the running variable is still suspect to manipulation as organizers can obviously alter the student intake. In our view, incentives for such manipulation are however low. While organizers get higher unit price below the threshold, they also lose funding from students that do not enroll. Consider for example a school that has 201 students. Let us also assume the average unit price is roughly on its' 2016 level at 6100 euros per student and that the school has no special components in its' funding. The total grant funding would be 1 226 100 euros (201*6100 €). If the organizer decides to manipulate its enrollment below 200, let us say to 190 students, indeed by Formula (3), the unit price would increase to 6344 euros. The total funding would however fall to 1 205 360 euros (190*6344 €). Thus purely from the formula perspective there should be no incentives for manipulation. Of course 11 students less would imply also savings but it is unlikely that actual savings or costs for that matter would strictly follow the formula. For example teaching expenditures are difficult to adjust smoothly. In practice a school of 190 students probably requires as much teaching resources to run as a school of 201 students, since a qualified teacher on each subject would need to be hired anyway. Moreover, because prospective students can seek admittance to any school they wish, the allocation of students to schools can be considered random also from this perspective.

[12] The jump at the proximity of the 60 threshold might be partly explained by the fact that typical high school education lasts three years/grades, whereas at the same time there is a tendency to gravitate class sizes towards twenty students in Finland.

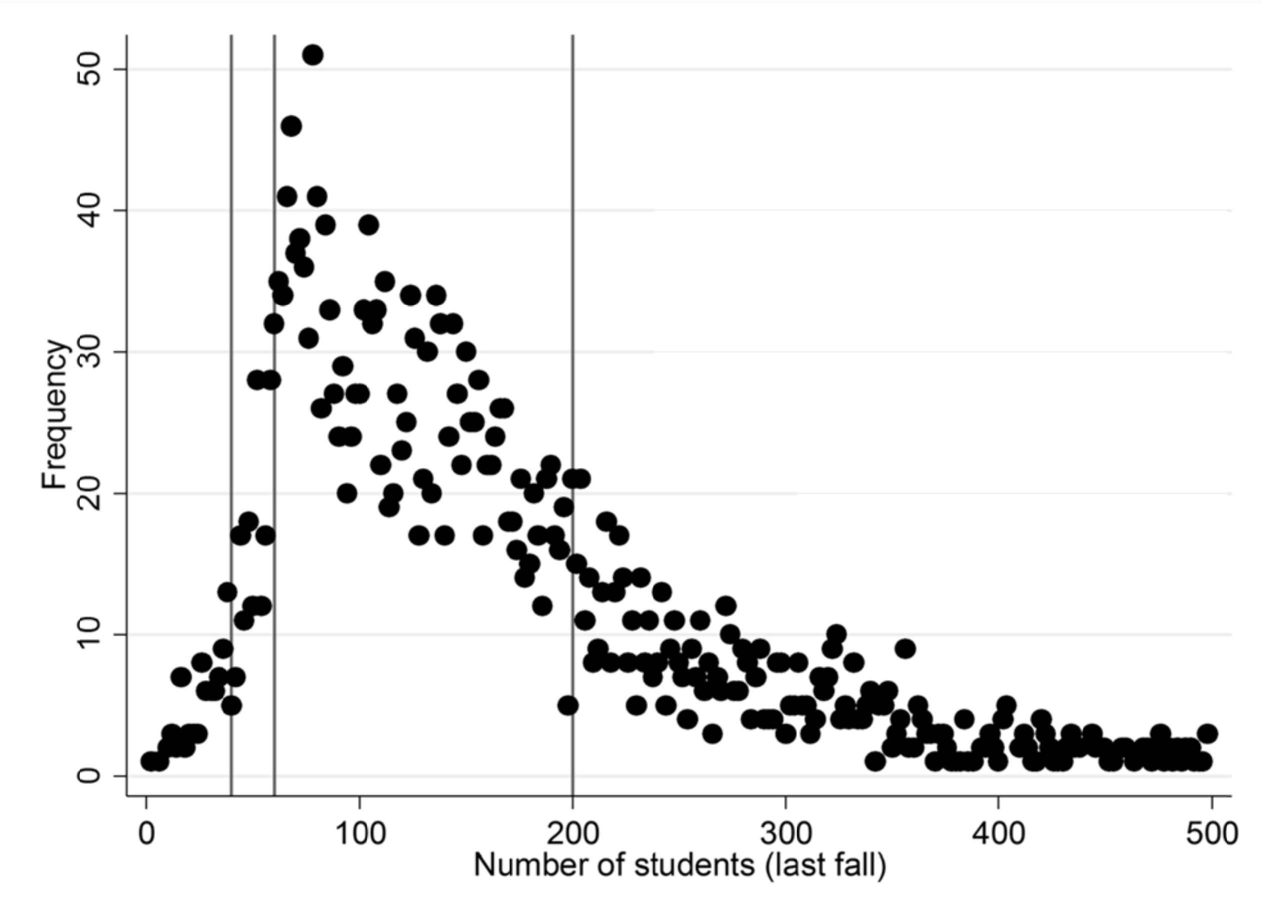
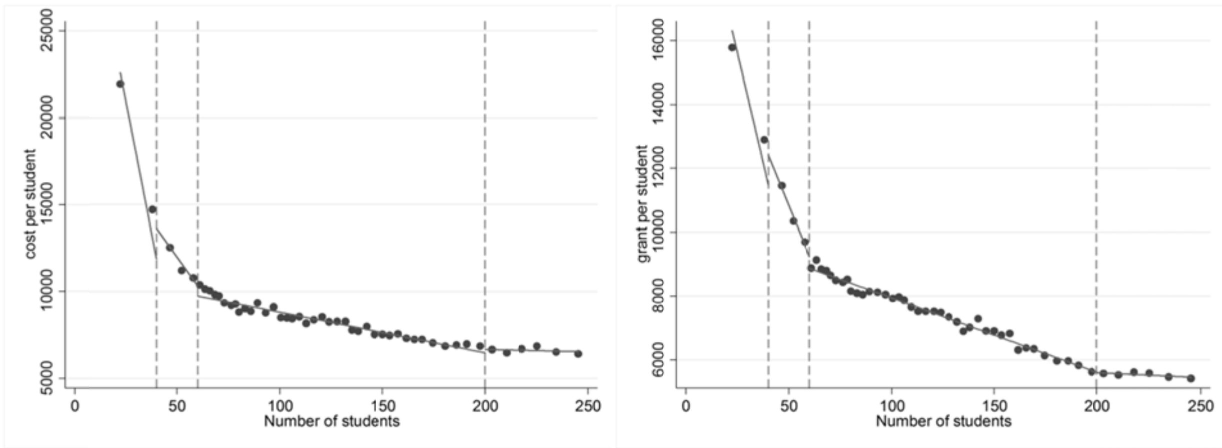


Fig. 3 The distribution of running variable (the number of students). *Note*: Municipal organizers with one school included.

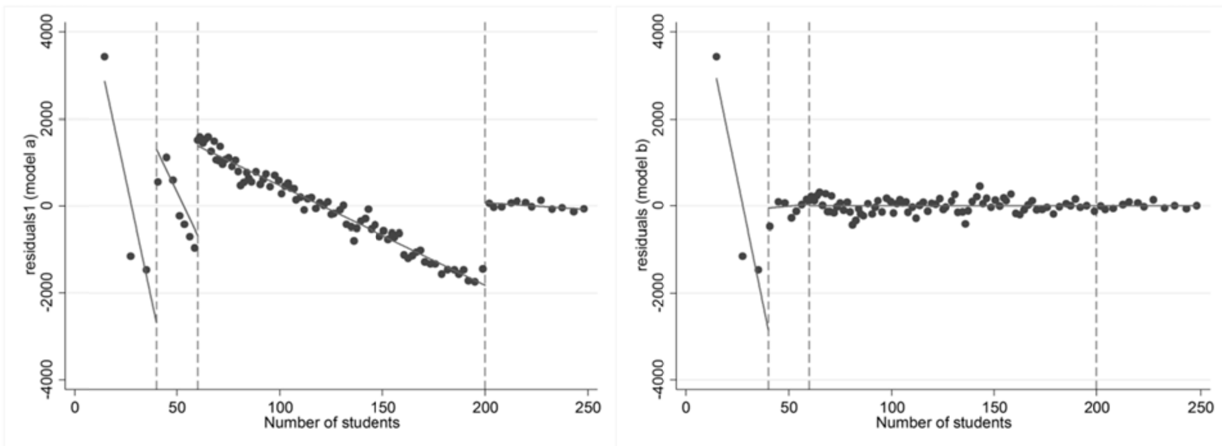
In Fig. 4 we plot expenditures and grants against the number of students (additional plots in AP4). While the slope changes at the kinks are somewhat less pronounced in terms of expenditures, there are still visually detectable changes in the slopes of the linear fits in expenditures. The fit line on the left side of 40 should be close to flat but due to outliers this is not the case. Fig. 5 further illustrates that the slope changes can act as relevant instrument by running two regressions where a) grants are explained by the three indicator variables which indicate whether observation is on the right side of the cutoff and b) where regression a) is augmented with the slope change variables. The strategy is to examine the linear fits of the residuals of these regressions. In the regression a) slopes of these fit lines should have a same sign than in the actual grant formula, whereas the residuals in regression b) should be relatively flat around zero.[13] The residual plots with the corresponding fits are shown in left (a) and right (b) panels of Fig. 5. Apart the interval from 0-40, the behavior of residuals is expected.



a **b**

Fig. 4 a Total costs per student and the number of students. **b** Grants per student and the number of students.

Note: The number of student limited to 250 and only municipal organizers with one school are included.



a **b**

Fig. 5 Visual examination of instrument relevance. **a** Residuals, model a. **b** Residuals, model b.

Last we test the covariate balance and placebo thresholds. In Table 2 we run regressions where covariates are in turn explained by the smooth function of students and the slope change

[13] This is similar strategy what Dahlberg et al. (2008) use when examining the instrument relevance. Since we have multiple cutoff points, we have to account for all these "treatments" in our graphical test of instrument relevance.

variable (see also AP5). We use both 1st or 3rd order polynomial control functions and include year and regional (county) fixed effects.[14] For these estimations we use the Calonico et al. (2016) bandwidth selector (CCFT bandwidth hereafter). Only share of high school age population and general grants are marginally significant at the 5% significance level and the significance depends highly from the order of the polynomial control. In Table 3 we check the effects at three different placebo thresholds by running a linear regression where grants per student are explained both with formula induced slope changes and placebo slope changes at points 150, 300 and 500. None of the placebo thresholds are significant and the slope changes at kinks 40, 60, and 200 have significant and expected signs.

[14] Results using 2nd order polynomial were similar and can be obtained from the authors by request. Note also that we use regional rather than municipal (organizers) fixed effects since the research design utilizes the cross sectional variation among municipalities. In addition we examine covariate balance with the covariate index approach suggested by Card et al. (2016). These results can be found in AP5.

Table 2 Covariate balance tests at threshold of 200 students

	1st order		3rd order	
Variable	**RK effect**	**Robust p-val**	**RK effect**	**Robust p-val**
0-14 year olds, % of total	0.000	0.233	0.003	0.168
15-19 year olds, % of total	0.000	0.044	0.000	0.901
Over 65 year olds, % of total	0.000	0.230	-0.003	0.165
Population	25.286	0.306	155.760	0.235
Average taxable income €/resident	2.259	0.856	149.886	0.071
Tax revenue €/resident	1.975	0.422	24.330	0.117
SOHC net costs €/resident	1.824	0.491	-15.918	0.347
Municipal council size	-0.011	0.762	-0.050	0.789
Municipal election vote turnout	-0.053	0.154	-0.173	0.341
Politcal orientation	0.001	0.819	-0.008	0.707
Swedish teaching	0.001	0.585	-0.001	0.844
Loan stock, €/resident	3.313	0.645	9.276	0.835
General state grants, €/resident	0.239	0.956	-54.233	0.039
Municipal staff	0.011	0.911	0.651	0.299

Note: Municipal organizers with one school included. Standard errors were clustered at the municipal level. CCFT optimal bandwidth used here is 44.78.

Table 3 Placebo thresholds

No controls				Controls			
Slope change	**Coefficient**	**S.E.**	**P-value**	**Slope change**	**Coefficient**	**S.E.**	**P-value**
K40	-235.63	33.48	0.00	K40	-195.49	17.10	0.00
K60	215.57	34.31	0.00	K60	178.11	18.27	0.00
K200	22.70	2.23	0.00	K200	21.93	2.39	0.00
K150	-3.26	2.99	0.28	K150	-4.37	3.24	0.18
K300	0.51	0.91	0.58	K300	-0.19	1.22	0.88
K500	0.15	0.76	0.85	K500	-0.18	1.00	0.86

Note: Standard errors clustered at the municipal level. All models include year and regional fixed effects and only municipal organizers with one school are included. The set of controls includes the variables from Table 3.

5. Empirical results

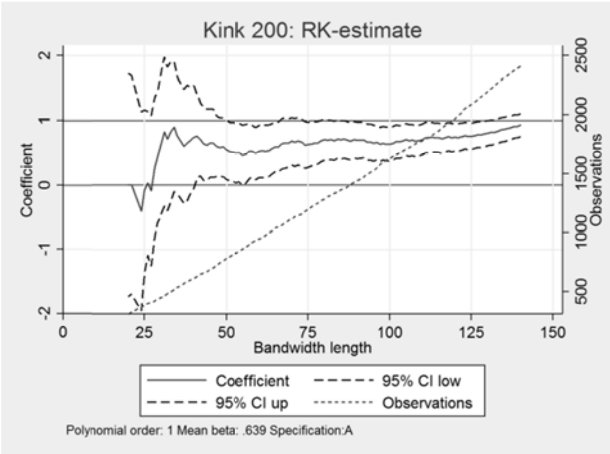
5.1 Flypaper results

In this section we present our main flypaper results. We consider three different model specifications which are labelled as A, B, and C. Specification A is the baseline and it has only grants on right-hand side, whereas B adds the set of control variables and C adds the regional (county) fixed effects to B. All specifications control for the smooth function of the number of students and include year fixed effects. We use regional rather than municipal fixed effects as we want to utilize the cross-sectional variation among organizers in identification. Standard errors are clustered at the municipal level. Monetary variables are in levels since the propensity to spend out of grant money corresponds to a grant coefficient estimated in levels (see e.g. Fisher, 1982).[15] The set of controls includes a standard set of municipal level socio-economic and political variables commonly applied in literature (see e.g. Baskaran, 2016; Ferede & Islam, 2015; Lundqvist, 2015; Gennari and Messina, 2014). We use the share of population of three different

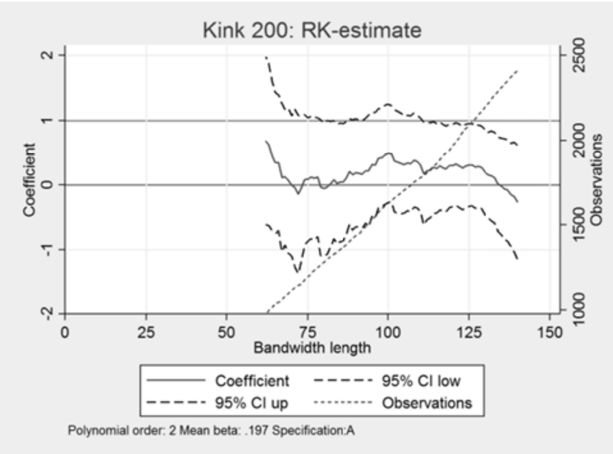
[15]Some authors have suggested that flypaper effects should be estimated with log-linear specification (Becker, 1996; Worthington & Dollery, 1999; Melo, 2002). Since most of the flypaper literature however uses level specification, we follow the same tradition for better comparison.

age groups (0-14, 15-19, and over 65 years old), total population, SOCH-costs, taxable incomes in previous year, and tax revenues to account for the fiscal capacity of the municipality, and a dummy variable if municipality offer teaching in Swedish. For political controls we use voter turnout in municipal elections, size of the local council, and a dummy whether the main left wing party gained higher share of votes in municipal elections than the main right wing party.

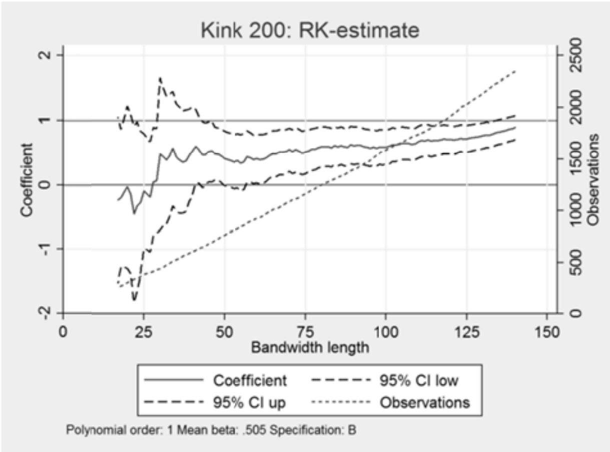
Results are shown in Fig. 6 (p=1 left panel, p=2 right panel). To avoid distortion in figures, we omit coefficient estimates for which the absolute value of the 95% confidence interval limits is above 2 and for which there are too few observations per estimated parameter using a rule of thumb 'ten observations per parameter' (small bandwidths). We report only bandwidths below 140 since beyond that we would confound the effect of the kinks 60 and 200 with each other. The bandwidth value is the length on one side of the threshold, thus the total length is twice this value.



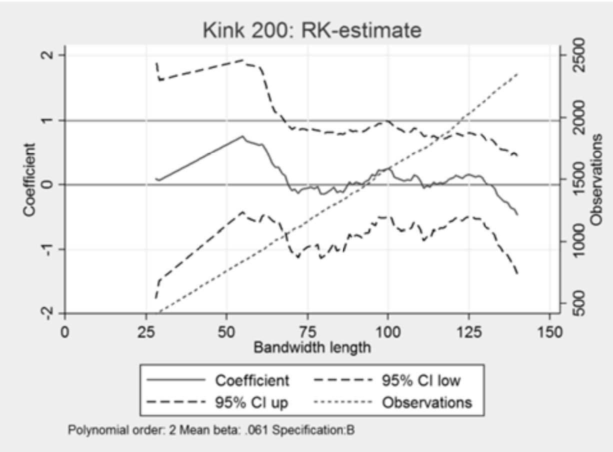
a Model A1



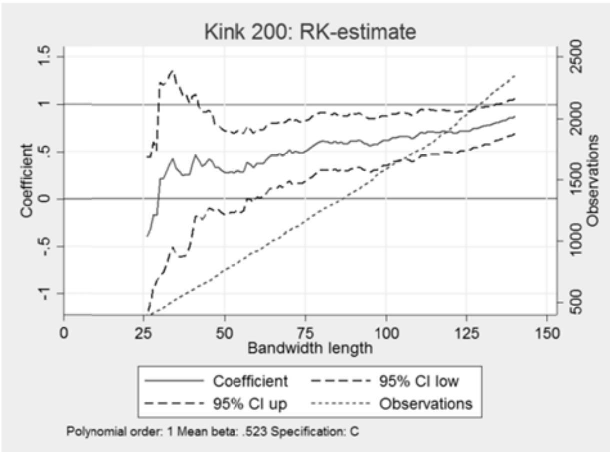
d Model A2



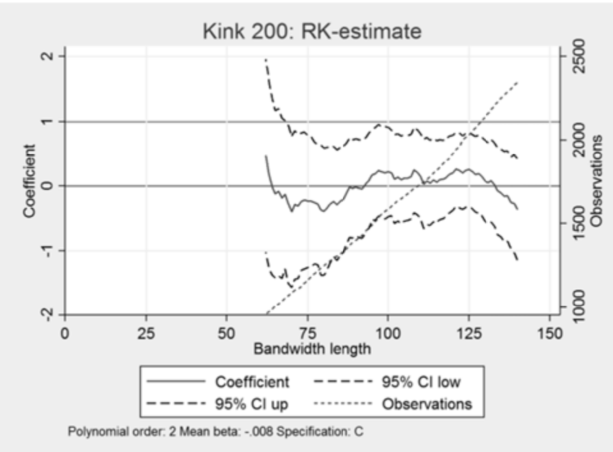
b Model B1



e Model B2



c Model C1



f Model C2

Fig. 6 a-f RK-estimates of the flypaper effect. *Note:* All figures have high school expenditures as the dependent variable and grant as the independent variable of interest. "Mean beta" = average coefficient estimate over all reported values.

The 1st order polynomial provides significant and quite robust results across specifications at least from bandwidth of 75 onwards. The 2nd order polynomial results are however insignificant and near zero coefficient estimates on average. The 3rd order polynomial specification (see AP6, Fig. A5) produces positive coefficients on average but the estimates are quite imprecise. The poor performance of higher order models has been noted for example by Card et al. (2016) who seem to favor 1st order specification (see also Ando, 2015b; Gelman & Imbens, 2014). We examine this issue more closely in the next section. The inclusion of covariates (specifications B & C) generally results somewhat smaller coefficient estimates on average, but with the 1st order polynomial specification, the results stay relatively robust as mean beta values are around 0.5-0.6 in all specifications. As expected, small bandwidth values produce volatile and imprecise results. With bandwidths from 75 to 100, we see relatively robust positive coefficients, whereas with larger bandwidths there is a slight detectable increasing trend in coefficient estimates towards unity. This trend is probably due to the fact that the grant correspondence with expenditures is higher among the larger organizers. Following these baseline results we conclude that while the results are rather sensitive both to bandwidth and to polynomial order, our preferred specification (1st order polynomial) suggest a relatively robust grant effect of around 0.5-0.6 with reasonable bandwidths. Interpreted in monetary terms this would imply that 1 € of additional grant money stimulate spending by 50-60 euro cents.

5.2 First stage results and additional robustness checks

Above we noted that the higher order polynomial specifications performed very differently from the first order specification. Often this might be due to poor first stage of IV as higher order may suffer from a problem of weak identification. Thus in Table 4 we present the coefficient estimates of the first stage along with its significance and the Kleibergen-Paap (K-P) test statistic for weak identification test (see e.g. Baum et al., 2007).[16] We present these results for all three polynomial orders and for both specifications A and C.

Table 4 First stage results and weak identification test

Specification A				**Specification C**			
1st stage coefficient				1st stage coefficient			
		Polynomial order				Polynomial order	
BW	**1**	**2**	**3**	**BW**	**1**	**2**	**3**
25	18.60***	10.69	52.24*	25	21.23***	10.13	50.29*
50	23.20***	14.02	3.722	50	22.00***	12.82	1.171
75	21.73***	26.15**	4.695	75	21.27***	23.02***	4.868
100	20.22***	24.99***	24.77*	100	19.98***	22.95***	22.95**
125	19.63***	23.07***	27.23*	125	19.98***	21.70***	24.83**
K-P stat.				K-P stat.			
		Polynomial order				Polynomial order	
BW	**1**	**2**	**3**	**BW**	**1**	**2**	**3**
25	15	0.40	2.28	25	37.29	0.32	2.56
50	30.83	3.00	1.11	50	36.36	4.92	1.37
75	86.96	4.38	3.99	75	76.31	7.32	4.72
100	244.7	7.48	4.37	100	258.4	7.05	5.84
125	296	16.68	14.44	125	477.6	15.91	16.39

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

The first stage results are non-robust with smaller bandwidths and higher order polynomials. With larger bandwidths all polynomial orders provide a significant coefficient for the 1st order instrument (the interaction $Z * [S_{it} - s_0]$ in Equation 6). However the addition of possibly irrelevant higher order instruments leads to a weak identification problem as indicated by low K-P statistics. Using the Staiger and Stock (1997) rule of thumb, only the 1st order specification consistently produces test statistics higher than 10 (see also Baum et al., 2007) suggesting preference towards this polynomial order. Furthermore the results are robust between the

[16] We report Kleibergen-Paap statistic instead of the usual Gragg-Donald statistic as the former is robust to within cluster correlation.

specifications A and C. Thus we focus to the specification A with 1st order polynomial control function in our subsequent analysis.

Table 5 presents several robustness tests using bandwidth values of 50, 75 and 100. The results (1) reproduce the estimates for model A1 at these bandwidths, while robustness checks from (2) to (4) use the baseline specification but modify estimation sample or the used fixed effects. Results in (5) reproduce C1 and (6) adds three additional controls, namely number municipal of staff, and other state transfers and loan stock per resident, while (7) omits years 2001-2002. Overall these robustness checks indicate that results are quite stable. Adding organizers with many schools in (3) has also only small effect as expected. There are not many organizers with multiple schools around the 200 student threshold.

Table 5 Robustness checks

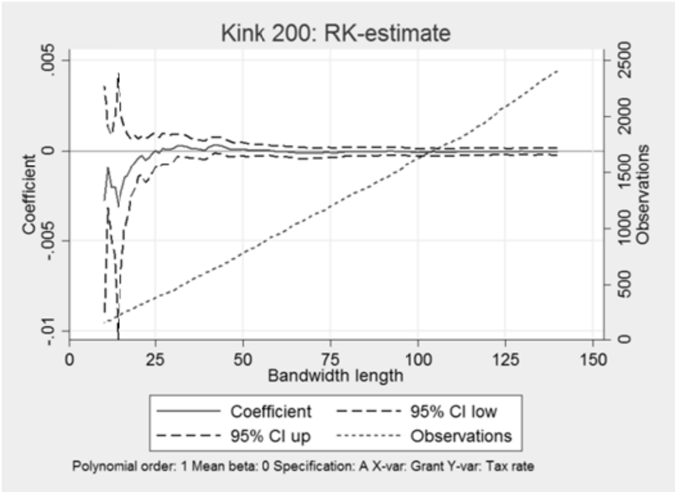
(1)	Baseline; 1st order, specification A			
Bandwidth	**Coefficient**	**SE**	**P-val**	**N**
50	0.544	0.231	0.020	782
75	0.625	0.178	0.001	1196
100	0.631	0.132	0.000	1627
(2)	**A1+Excluding years 2001 and 2002**			
Bandwidth	**Coefficient**	**SE**	**P-val**	**N**
50	0.625	0.247	0.013	615
75	0.675	0.179	0.000	969
100	0.687	0.135	0.000	1332
(3)	**A1+ Organizers with many schools included**			
Bandwidth	**Coefficient**	**SE**	**P-val**	**N**
50	0.493	0.292	0.094	841
75	0.633	0.176	0.000	1289
100	0.607	0.135	0.000	1739
(4)	**A1+Regional FEs added**			
Bandwidth	**Coefficient**	**SE**	**P-val**	**N**
50	0.519	0.250	0.040	782
75	0.689	0.172	0.000	1196
100	0.689	0.128	0.000	1627
(5)	**Specification C1**			
Bandwidth	**Coefficient**	**SE**	**P-val**	**N**
50	0.280	0.225	0.215	765
75	0.511	0.162	0.002	1161
100	0.617	0.134	0.000	1585
(6)	**Specification C1 with added controls**			
Bandwidth	**Coefficient**	**SE**	**P-val**	**N**
50	0.278	0.216	0.199	759
75	0.528	0.161	0.001	1150
100	0.636	0.133	0.000	1559
(7)	**Specification C1 excluding years 2001 and 2002**			
Bandwidth	**Coefficient**	**SE**	**P-val**	**N**
50	0.275	0.273	0.316	603
75	0.506	0.158	0.002	943
100	0.603	0.134	0.000	1303

5.3 Grant effects on other outcomes

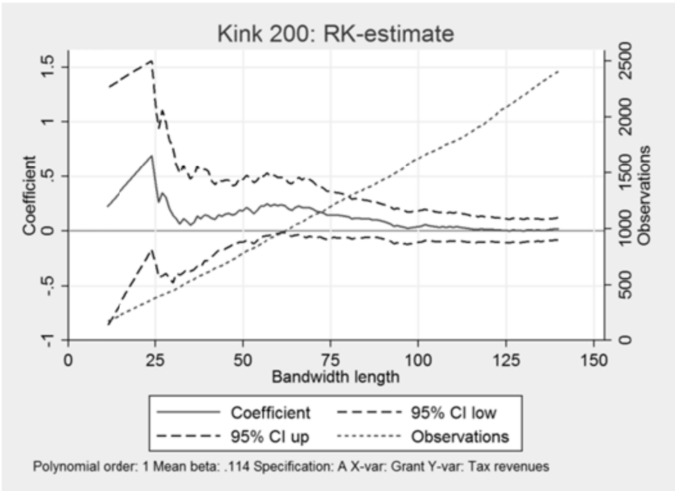
Results so far suggest that high school grants contribute positively to local high school spending. Whether this indicates flypaper effect depends also from the size of the income effect. The challenge is the lack of good research design for incomes. One option is just to look at the coefficient estimate of the income variable when it is included as a control. In AP we present these income estimates from previously reported Model C1. The results suggest that taxable income has little effect on spending but we wary putting too much stress on this result. Earlier findings do not offer much guidance either about the possible magnitude of the income effect on local spending in Finland. Only Oulasvirta (1997) and Moisio (2002) have provided some estimates, suggesting that the effect of income is order of magnitude smaller than effect of grants. Elsewhere, recent results by Gennari and Messina (2014), Ferede and Islam (2015), and Dahlby and Ferede (2016) all suggest that while grant effect is in the order of magnitude 10^{-1}, the income effects often fall to the order of magnitudes of 10^{-2} or even 10^{-3}.

In the absence of a good research design for income variable, studies often examine whether local tax rates or tax revenues respond to grants (see e.g. Baskaran, 2016; Lundqvist, 2015; Dahlberg et al., 2008). In the first panel of Fig. 7 we explain the municipal income tax rate with grants and find insignificant results. Variation in spending may also occur because there are changes in the tax base. While grant seems to have a positive effect on average on tax revenues, this effect is hardly significant and is much smaller than the grant effect on spending (second panel in Fig. 7). Last, it is possible that municipalities just divert grant money elsewhere than to education. The last panel in Fig. 7 examines the high school grant's effect on social and healthcare spending. Based on the results, municipalities may slightly increase their SOHC spending as a result of high school grant but this effect is small relative to its' effect on high school spending and often statistically insignificant.

Our results can be compared to Lundqvist (2015) who found a significant negative correlation of general grants with tax revenues also using Finnish data. This relationship was however much smaller than between general grants and expenditures, suggesting the presence of flypaper effect. She also found that the basic education grants had no bearing on tax revenues, even though the basic education is an expense category much larger than high school education. Interestingly school expenditure increases were more associated with labelled grants than with unlabeled grants. According to Lundqvist, potential explanation behind this observation is that nominal labelling of grants might direct spending decisions even though grant is not tied to any specific purpose. Thus in our case it is possible that the grant formula acts as *de facto* binding restraint for the local decision makers not to divert funding outside high school education.



a



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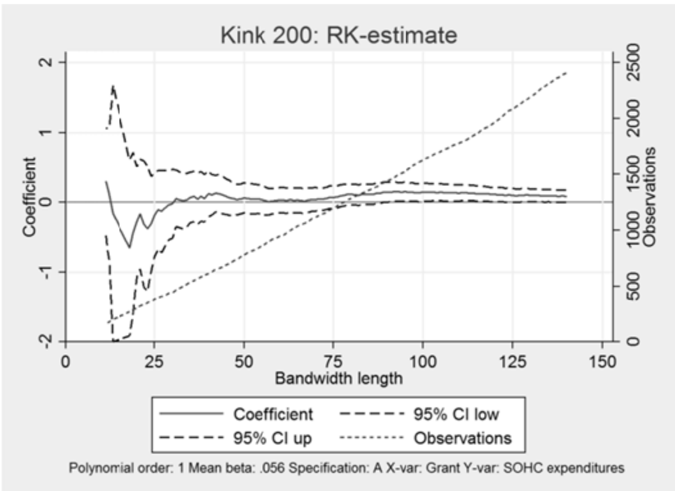

c

Fig. 7 Grant effect on **a)** tax rates, **b)** tax revenues and **c)** SOHC-spending. *Note:* Single school municipal organizers included in all three figures.

6. Heterogeneous local responses to high school education grants

In this section, we examine the heterogeneous spending responses to high school grants. We do this by dividing the data into subsamples according to some municipal characteristics, replicating the earlier estimations (with specification A1) for these subsamples, and looking for any differences between the grant coefficients between these subsamples. Due to sample split, we cannot consider very short bandwidths and based on our visual observation of earlier results we use the bandwidth of 75.

Before results, let us briefly discuss the municipal characteristic that we consider as the potential sources of heterogeneity. To test the intergenerational conflict hypothesis, we use the share of 65 year old population in the municipality, a variable used also in many other studies examining the intergenerational conflict issue. For consistency check, we also use the share of 15-19 year old population in the municipality. We would expect that estimations using these two variables would produce opposing results. In addition to demographics, we examine also other possible sources of heterogeneity identified earlier in the literature.

First, following Vegh and Vuletin (2016), we divide the sample by different tax rates. According to Vegh and Vuletin (2016), with higher tax rates, the higher resulting tax distortion induces to spend more from transfers than from incomes (see also Dahlby and Ferede, 2016). Second, we examine sub samples with respect to income levels as the ability of municipality to offset local funding by grants may depend from it (Lutz, 2010). Third, we consider whether political participation (voter turnout) of citizens affects how municipalities respond to grant. For example Borge et al. (2008) and Geys et al. (2010) have provided evidence that local government (cost) efficiency is positively related to higher voter turnout due to higher accountability. This effect is larger, the larger the degree of local fiscal autonomy is.[17] Fourth, we divide the sample with respect to SOHC-costs. For example de Mello et al. (2016) find that

[17] Martin (2003) has pointed out that in US, the members of the congress may have distribute federal funding towards areas with higher voter turnout as these areas are more likely to provide future support for them.

areas with higher elderly share prefer higher healthcare expenditures over education expenditures. Last, the size of the municipal council might affect preferences towards spending. For example, Egger and Koethenbuerger (2010) found that larger councils tend to spend more, consistent with the standard fiscal commons problem. Petterson-Lidbom (2012) on the other hand found that the size of local council negatively affects the local spending using both Swedish and Finnish data. According to him, larger councils are in better position to supervise the budget maximizing bureaucrats who often have considerable power in setting the actual spending agenda.[18]

Except for tax rates and council size, the data is divided into two subsamples based on the median value of given variable among municipal organizers. Since tax rate and council size change discretely, there is a large group of observations that fall on the exact median. In these cases we divide the sample into three groups, the additional group being the median group. The results for the subsample analysis are presented in Table 6.

[18] The composition of municipal councils can also matter. A recent study by Hyytinen et al. (2017) finds that the higher number of health care sector public employees in the Finnish municipal councils induces the councils to spend more on the health care sector. This is likely also in the case for educational sector employees.

Table 6 Heterogeneous grant responses

Variable	Median	Grant effect when below median	Obs.	Grant effect when above median	Obs.
Share of 65 year old and higher (0-1)	0.201	0.665***	643	0.377	553
		(0.187)		(0.309)	
Share of 15-19 year old (0-1)	0.063	0.404	444	0.697**	752
		(0.267)		(0.209)	
Voter turnout (%)	62.00	0.193	541	0.890***	655
		(0.273)		(0.221)	
Taxable Income (€/resident)	12805.92	0.459	648	0.869***	548
		(0.301)		(0.199)	
SOHC-costs (€/resident)	3251.818	0.608**	754	0.497	442
		(0.184)		(0.364)	
Municipal tax rate % (median=19)					
Below median		0.465	478		
		(0.279)			
At the median		0.788**	242		
		(0.296)			
Above median		0.667**	476		
		(0.250)			
Council size (median=35)					
Below median		0.989***	468		
		(0.193)			
At the median		0.624*	597		
		(0.294)			
Above median		0.330	131		
		(0.407)			

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Note: Median calculated among all municipal organizers, but estimation results include only municipal organizers with one school. Standard errors are clustered at the municipal level in parentheses. Bandwidth: 75, polynomial order: 1, specification: A in all estimations.

For the municipalities with larger than median share of elderly, the response to grants is statistically insignificant. On the other hand, the municipalities that have lower than median share of elderly have relatively large and significant response. We interpret this so that in municipalities with high share of elderly, high school spending does not respond to additional grants so much as they probably divert the money to other uses. When we divide the sample according to the share of 15-19 year old population, the magnitude and the significance of the coefficients is reversed, as expected. Now the municipalities with higher share of high school age population respond more to grants. The results hold for various bandwidths (see AP7). These results provide support for the intergenerational conflict hypothesis in the sense that demographically older areas seem to direct less grant funding towards education.

Considering voter turnout, the results imply that the higher the turnout is, the larger is the grant response as councilors may feel stringer accountability in their spending decisions under the higher control by the electorate. The higher incidence of grants in high income municipalities suggest that these municipalities do not need to shift state funding to other areas. Also the demand for education is also likely to be higher in these areas. With respect to tax rate, a higher tax rate seems to be related to a larger grant effect. According to Dahlby and Ferede (2016), higher taxation is related to larger marginal costs of public funding, which again is related to a higher degree of flypaper effect.

The sample split in terms of SOHC-costs produces expected results assuming that aging municipalities prefer SOHC-costs over education costs. The size of the local council seems to affect differently than what Egger & Koethenbuerger (2010) found. Our results indicate that grant response in municipalities with smaller councils is much higher. One possible explanation may be that in smaller councils the public (education) employees who are councilors exert more influence on how the grant should be used (see Hyytinen et al., 2017). The mechanism offered by Petterson-Lidbom (2012) also coincides with our results as in municipalities with smaller councils the administrative (education) bureaucrats may have more influence on how the funds are spent. Here it is also good to note that council size is directly determined by the municipality size. Thus our result might simply reflect the fact that smaller municipalities generally spend more in per student terms which again might explain the higher level of grant incidence.

There are however some caveats to these heterogeneity results. First, the measured municipal characteristics may mask the actual mechanism causing heterogeneity. For example voter turnout does not reveal who in fact votes although the mechanism probably runs through the composition of the active electorate (see e.g. Fletcher & Kenny, 2008). Demographic characteristics alone on the other hand do not necessarily capture that elderly may actually prefer education spending due to altruistic reasons or because of possible increases in property values. Moreover, many of the municipal characteristic go hand in hand, thus it might be difficult to pinpoint the origins of heterogeneity to any single municipal characteristic. Second, small sample sizes lead to relatively large standard errors for the coefficient estimates, suggesting that not all of the differences between coefficients are statistically significant. Lastly, we have taken for granted here that the identification assumption of our design is valid in each of the subsample. Despite these caveats, the heterogeneity results suggest that the current policy of not tying the grants to any specific use seems well grounded. While nominal labelling of grants seems to guide the local spending to a certain degree (the flypaper result), following the standard arguments of fiscal federalism literature, it seems beneficial to allow leeway in municipal spending decisions when municipalities have varying preferences towards different spending categories. This interpretation of our findings is also supported by interviews which were done with few municipal officials (see AP8).

7. Conclusions

This study examined the Finnish system of high school education funding and its effects on the local high school spending. Utilizing exogenous variation in high school grants arising from a piecewise linear grant formula, we estimated a statistically significant positive effect of grants on high school spending with multiple different model specifications. Although the magnitude and significance of this effect varied to some extent, invariably insignificant grant effects on municipal tax rates and tax revenues support the presence of a flypaper effect. The distinctive feature of our study is that we examine also heterogeneity in grant responses. According to our results a larger share of elderly residents is related to a lower propensity to spend on education out of high school grant funding. This result lends support to the intergenerational conflict of education spending hypothesis. In addition we analyzed heterogeneity with respect to several other municipal characteristics, such as voter turnout, local council size, and social and healthcare spending.

In future analyses, some aspects of our study could be improved upon. First, due to data limitations our analysis was restricted to the municipal/organizer level. Thus the mechanism underlying the allocation of grants at the school level is left unrevealed. Second, the examination of heterogeneous responses to grants would require a more careful account of the endogeneity. Especially the demographic structure of a municipality is likely to be endogenous due to Tiebout type sorting, as older citizens move to areas which provide less schooling services to begin with. Third, our results mainly concern a restricted subset of Finnish high schools as the municipalities for which the grant formula is relevant are relatively small. Consequently we are wary of making generalizations concerning larger organizers of high school education from our results.

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APPENDIX

AP1 Further summary statistics

Table A1 Summary statistics for municipal organizers with multiple schools

Variable	N	Mean	SD	Median	Min	Max
High school education costs, €/student	639	6682.59	1179.65	6410.51	4514.42	13151.34
Grant €/student	639	6007.86	848.12	5919.38	4932.48	9841.00
Cost vs. Grant difference, €/student	639	674.74	835.35	563.15	-1499.92	4041.14
Students (previous fall)	639	1278.69	1546.73	823.00	119.00	8835.00
SOHC net costs €/resident*	638	3252.63	355.78	3224.42	2491.75	4328.00
Tax income €/resident	639	3823.64	645.62	3707.84	2551.81	7637.18
Population	522	69777.31	96771.20	37985.00	6845.00	621000.00
0-14 year olds, share of total	522	0.17	0.03	0.17	0.12	0.25
15-19 year olds, share of total	522	0.06	0.01	0.06	0.05	0.09
20-24 year olds, share of total	522	0.06	0.02	0.06	0.03	0.12
Over 65 year olds, share of total	522	0.17	0.04	0.17	0.08	0.31
Municipal election vote turnout	130	59.40	5.16	58.70	50.90	79.50
Municipal loan stock, €/resident	633	2081.03	1175.44	1906.06	1.29	7165.00
Municipal income tax rate	639	18.83	1.04	18.75	15.00	22.00
Size of local council	130	51.85	12.12	51.00	27.00	85.00
Taxable income, t-1, €/resident	639	16575.32	3611.52	15853.62	10772.61	39268.51
Other state transfers, €/resident	638	1252.15	591.58	1215.25	9.03	3227.00
Municipal staff (per 1000 residents)	638	61.75	13.60	61	29	134

*Net costs are the difference between the gross operating cost and operating income. Some SOHC-services have user fees, thus net costs can be seen as a more informative cost measure.

Table A2 Summary statistics by the grant formula thresholds

Mean values	**Interval**			
Variable	**<40**	**≥ 40 <60**	**≥ 60 <200**	**≥ 200**
Cost per student	20752.83	11698.57	8340.19	6368.57
Grant per student	14832.75	10614.06	7470.47	5541.74
Students	27.08	51.48	120.12	325.39
Observations on the interval	84	171	1839	810

Standard deviations

	Interval			
Variable	**<40**	**≥ 40 <60**	**≥ 60 <200**	**≥ 200**
Cost per student	10113.18	1976.12	1497.06	796.64
Grant per student	4107.98	1272.84	1188.98	448.96
Students	9.14	5.54	39.52	138.00
Observations on the interval	84	171	1839	810

AP2 Descriptive correlation analysis

Table A3 Pairwise correlations

		1	2	3	4	5	6	7	8
1	High school costs (€/student)	1							
		1							
2	Students	-0.46	1						
		-0.21	1						
3	Total population	-0.39	0.90	1					
		-0.18	0.98	1					
4	Share of 15-19 year old	-0.35	0.20	0.10	1				
		-0.32	-0.08	-0.11	1				
5	Share 65 and over	0.35	-0.48	-0.47	-0.62	1			
		0.39	-0.30	-0.27	-0.55	1			
6	SOHC-costs (€/resident)	0.49	-0.36	-0.32	-0.48	0.72	1		
		0.48	-0.07	-0.06	-0.46	0.71	1		
7	Taxable income (€/resident)	-0.24	0.59	0.70	-0.06	-0.46	-0.24	1	
		-0.26	0.47	0.43	0.00	-0.48	-0.20	1	
8	Municipal income tax rate	0.32	-0.26	-0.15	-0.16	0.30	0.66	-0.11	1
		0.33	-0.24	-0.19	-0.15	0.37	0.64	-0.28	1

Upper correlation coefficient includes only one school municipal organizers, lower all municipal organizers.
Correlations with population share use the original variables without the 2001-2002 replacement (see footnote 10 in the main text).

The negative correlation of per student costs with the number of students implies economies of scale. Larger organizers do spend more in terms of total sums of course, but in per student terms they generally spend less than smaller organizers. Two demographic share variables have negative correlation with each other as expected. Elderly people also tend to locate more in smaller rural areas as its correlation is negative with the total population. Interestingly, the share of elderly shows positive correlation with both the high school costs and SOHC-costs. In latter case this is expected, but the former would suggest that high school education is favored more in municipalities with higher share of elderly people. As Fletcher and Kenny (2008) point out, although the high share of elderly may shift the local preferences towards less education spending in total, it also means a lower share of school age population, which in fact can increase the per pupil spending. The share of high school age population shows little correlation with the total population, while the actual number of high school students shows an expected large correlation with it. Larger municipalities however often have large populations of higher education students (university students) and working age people. Consequently the share of 15-19 might be relatively low although the absolute size of this age group would be large. In fact, we see that the correlation between the share of high school population and total population turns negative when larger municipalities are added. Income level has expected correlations given the fact that larger municipalities generally are wealthier. The correlations with the tax rate show that municipalities seem to tax more in order to finance the higher social and healthcare costs often due to the aging population. Among single school municipalities, tax rates show relatively little correlation with the income level, suggesting that income level may have relatively small relationship to the level of public spending among these communities. The correlation between tax rate and income level becomes slightly stronger when organizers with many schools included.

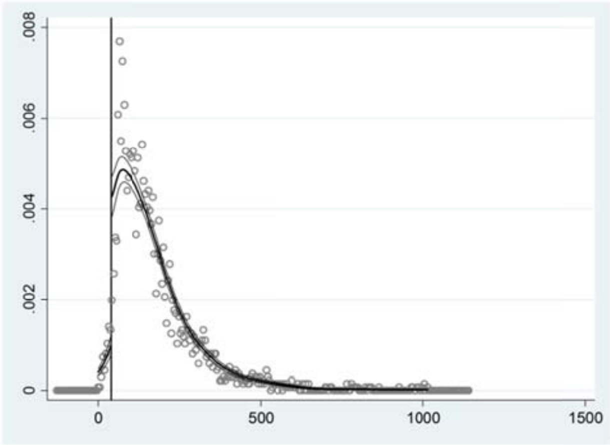
AP3 McCrary (2008) test for the discontinuity of the running variable

Here we first conduct the McCrary (2008) test of discontinuity for the running variable density (see **Fig. A1**). We have limited the examination to the municipal organizers with one school. Based on this test, only at the threshold of 200 the distribution is sufficiently smooth in order to guarantee that no manipulation assumption is valid. Since McCrary test requires the pre-binning of the data, Cattaneo et al. (2016a; 2016b) have suggested a test that avoids the definition of this additional parameter. Moreover their approach uses a bandwidth selection that generally yields smaller bandwidths. Below we employ additional testing using their robust bias-corrected test statistic, with a second order polynomial for the density estimation and third order polynomial for the bias correction. We also allow asymmetric bandwidths on each side of the thresholds. Now we cannot reject the null hypothesis of continuity in any of thresholds. Intuitively this is expected as closer the threshold we are, the harder it is to reject this null. Anyhow the threshold of 60 is still the "worst performing" as it obtains the lowest p-value, thus being closest to rejection. Lastly we test, whether the first derivative of the running variable density is continuous at the thresholds. To test this, we regress the number of observations in each bin (using bin width of 2) on the flexible polynomial function (third order) of the student number (centered at the kink) and the corresponding slope change variable. The coefficient in this regression for the slope change should be statistically insignificant. In none of the regressions the slope change has a significant coefficient, which lends credibility for the validity of no manipulation.

[**Fig. A1** on the next page]

AP3 continues

Kink 40 a

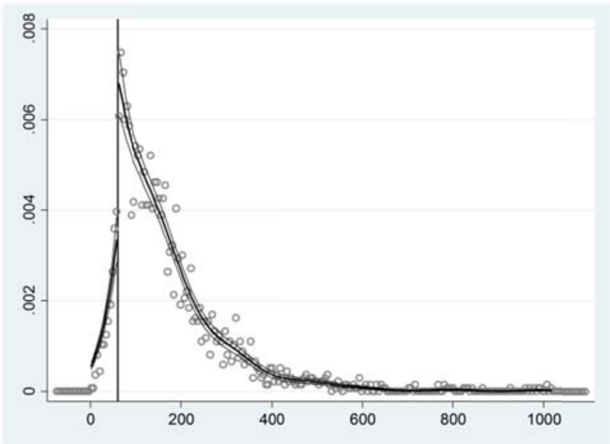


McCrary test
Bin size= 4.70
Bandwidth=126.47
Log difference in height (standard error):
1.448 (0.128)
t-statistic: 11.35

Cattaneo et al. test
Bandwidth (left ; right): 20.098 ; 20.861
t-statistic: -0.004
P-value: 0.9970

Continuity of the first derivative:
Slope change coefficient: -0.206
p-value: 0.579

Kink 60 b

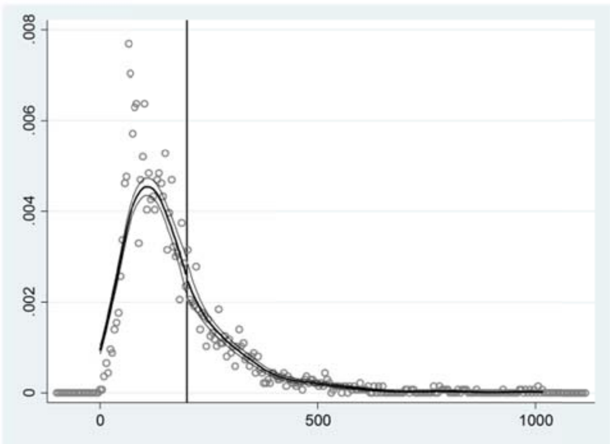


McCrary test
Bin size= 4.70
Bandwidth=75.13
Log difference in height (standard error):
0.674 (0.097)
t-statistic: 6.94

Cattaneo et al. test
Bandwidth (left ; right): 24.008 ; 24.442
t-statistic: 1.285
P-value: 0.1987

Continuity of the first derivative:
Slope change coefficient: -0.253
p-value: 0.212

Kink 200 c



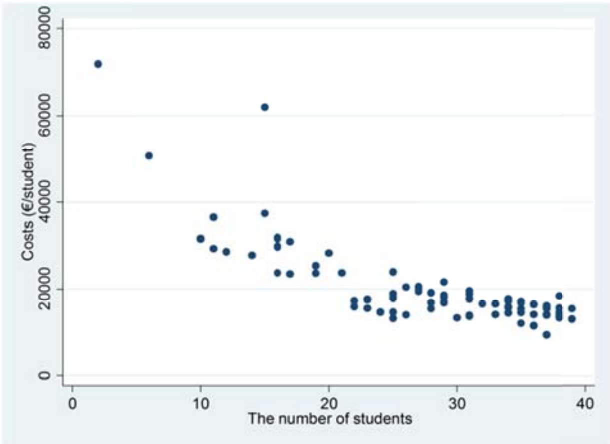
McCrary test
Bin size= 4.70
Bandwidth=94.72
Log difference in height (standard error):
-0.0116 (0.118)
t-statistic: -0.098

Cattaneo et al. test
Bandwidth (left ; right): 30.761 ; 32.771
t-statistic: -0.1101
P-value : 0.912

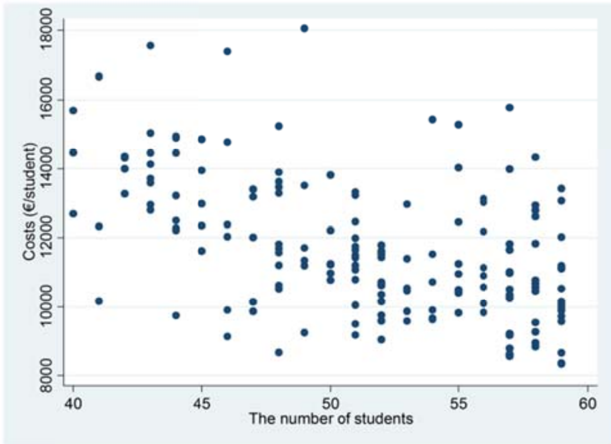
Continuity of the first derivative:
Slope change coefficient: 0.159
p-value: 0.120

Fig. A1 Discontinuity tests for the density of the running variable **a)** kink 40, **b)** kink 60, **c)** kink 200.

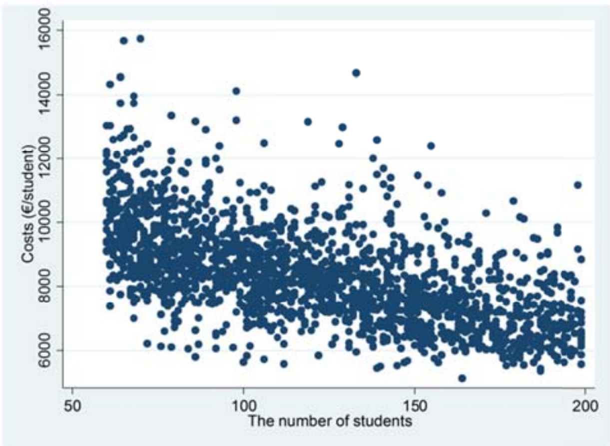
AP4 Additional scatterplots of costs, grants, and the number of students



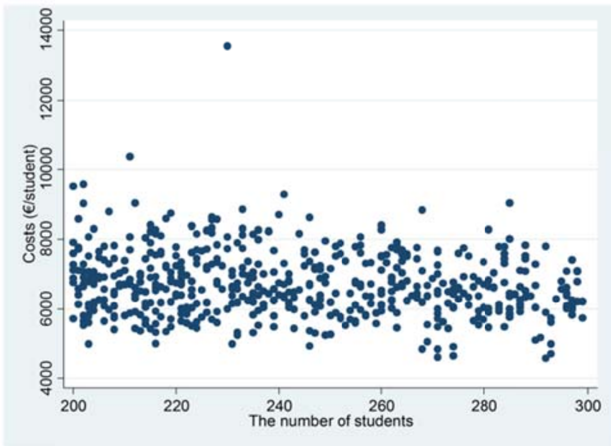
a



c



b



d

Fig. A2 a-d High school education costs per student against the number of students by the formula interval *Note:* All municipal organizers included.

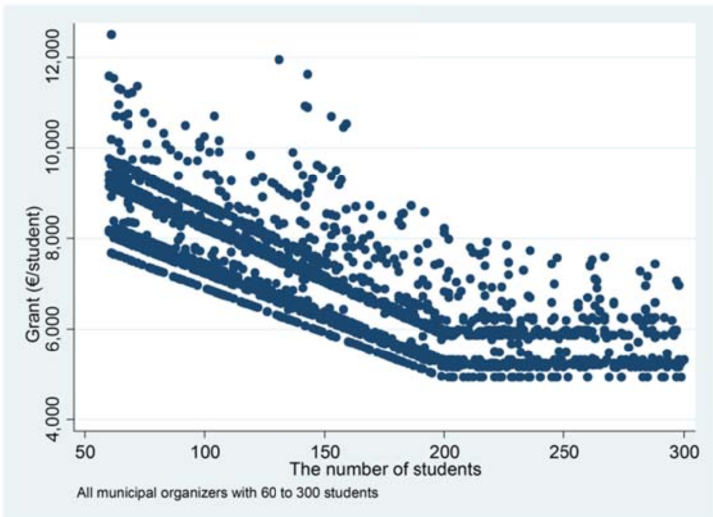


Fig. A3 Grants and the number of students. *Note:* The number of students is limited to below 300.

AP5 Covariate index approach for testing covariate balance

We also use the covariate index approach by Card et al. (2016) by running a simple regression of costs on all covariates shown in Table 2 in the paper and examine how the fitted values ("covariate index") from this regression behave around the thresholds. In a valid design the index should go smoothly through the threshold. In Fig. A4 the index goes smoothly (no detectable kink) through the threshold of 200.

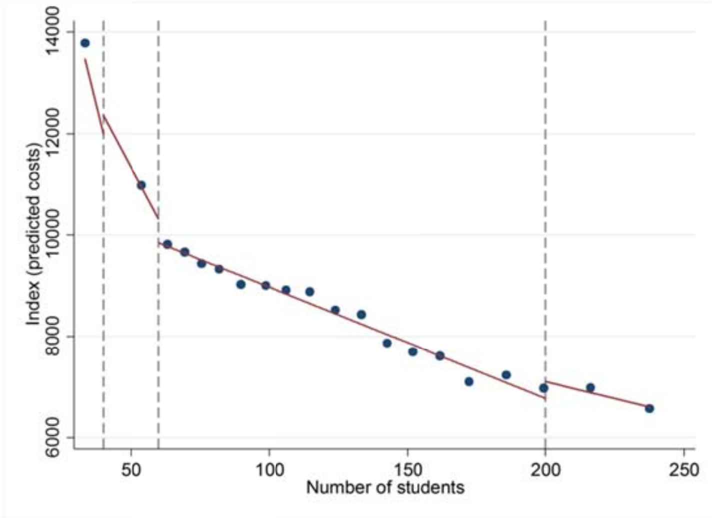
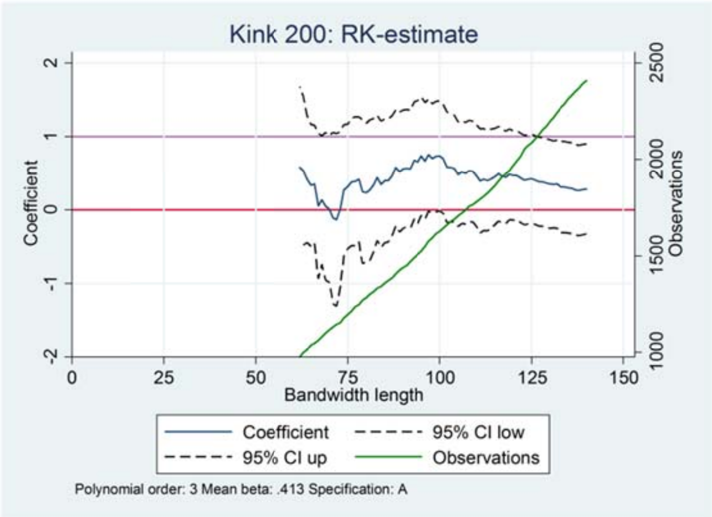
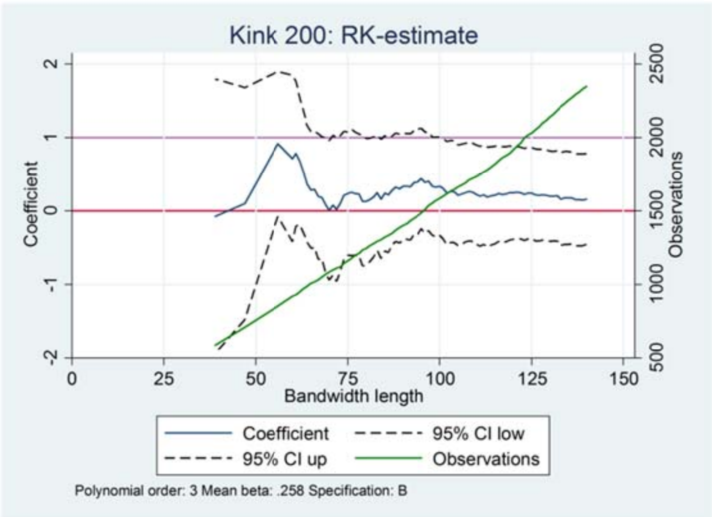


Fig A4 Covariate index test of design validity

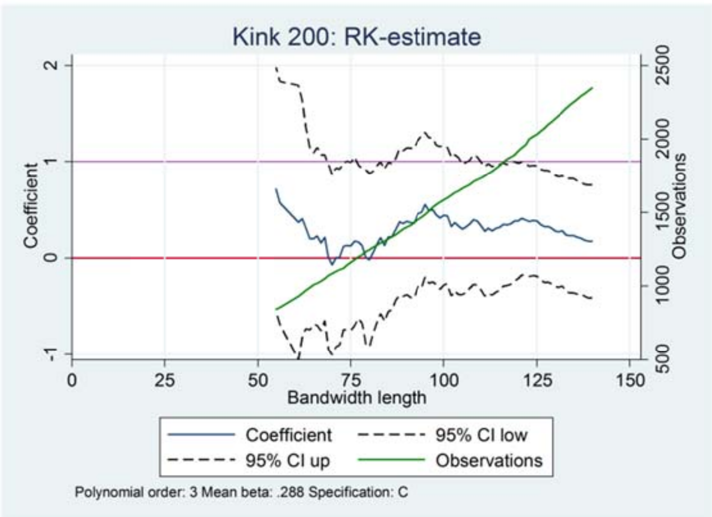
AP6 Additional estimations



a Model A3



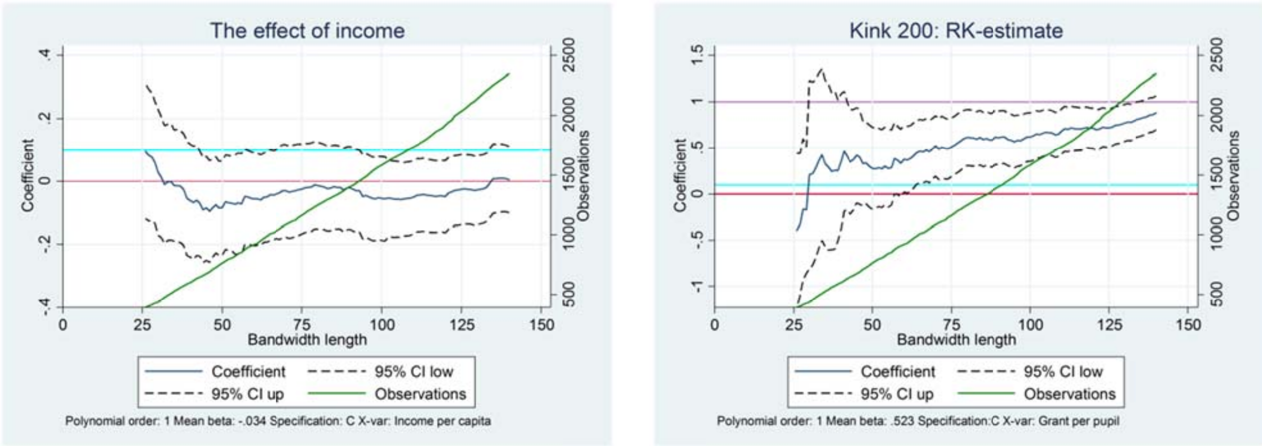
b Model B3



c Model C3

Fig. A5 a-c RK-estimates of the flypaper effect, 3rd order polynomial order

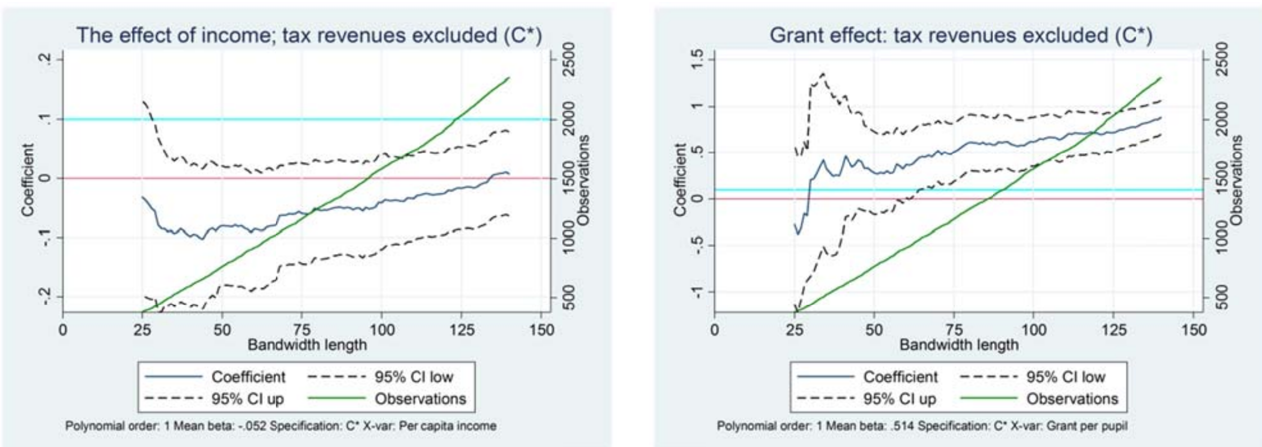
AP6 continues



a **b**

Fig. A6 a The effect income on spending in Model C1, **b** Grant effects in Model C1.

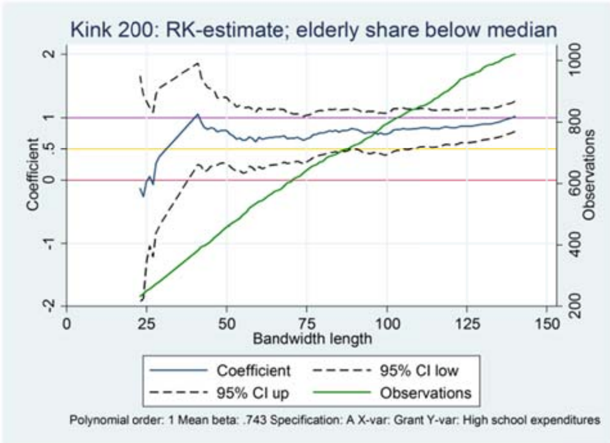
The effect of income (left panel) is quite expectedly negative on average as wealthier and larger municipalities generally spend less per student. The effect is however statistically insignificant over all bandwidths. For comparison we reproduce the figure of the grant effect from model C1 (right panel). With small bandwidths the lower bound of confidence interval for grant effect does cross the upper bound of income effect, thus suggesting that the effects would not differ statistically. But after around 75 students the lower bound of grant effect starts to diverge further from the 0.1 line while the upper bound for the income effect remains close that line, implying that with these bandwidths the difference is also statistically significant. One might be also concerned that since we control both income and tax revenues in specification C, this affects the effect of income since these two are highly correlated. Thus in Fig. E.3 we run exactly the same model than in Fig. E.2 but we exclude tax revenues from the set of control variables. The results are not much affected. While the effect of income is somewhat larger on average in absolute terms, it still fails to be statistically significant.



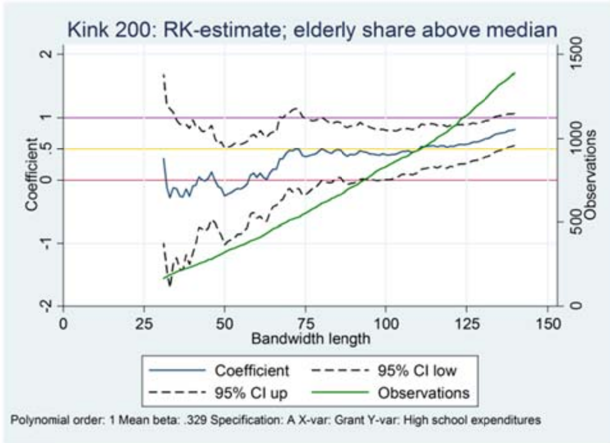
a **b**

Fig. A7 Income (**a**) and grant effects (**b**), alternate specification C*

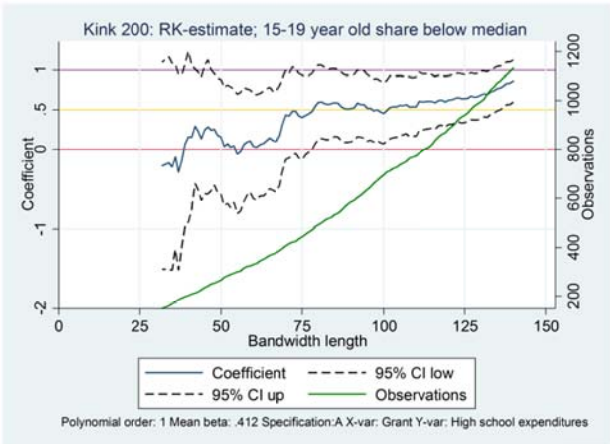
AP7 Demographic heterogeneity in grant response; sensitivity to bandwidth



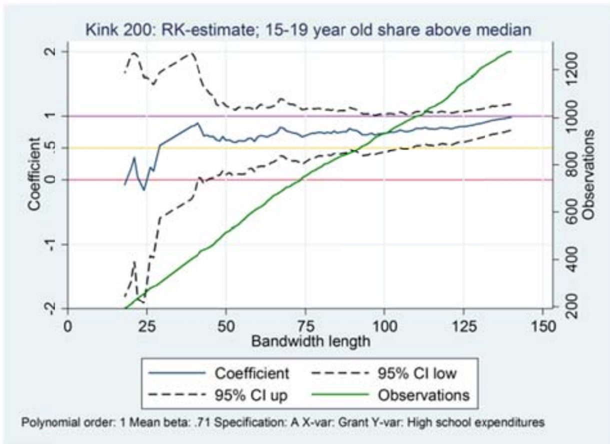
a



c



b



d

Fig. A8 a-d Bandwidth analysis of demographic heterogeneity estimates. *Note:* Single school municipal organizers included in all panels.

The above figures support our point estimate finding in Section 6. Moreover, while in all cases the estimates show an increasing trend in the magnitude of the coefficient, in all figures the estimates are relatively stable over a long range of bandwidth values. Due to the small sample sizes, the confidence intervals remain quite wide across the board. Nevertheless the differences in coefficient magnitudes on average point towards differences among municipalities with differing demographics in how they respond to high school grants.

AP8 Anecdotal interview observations

Here we briefly present some additional insights about the workings of Finnish high school funding by presenting anecdotal observations gathered from the interviews with the municipal officials. The purpose of these interviews was to see whether our empirical findings reflect the real-life practices of the municipal governance in any way. We interviewed three municipal officers in charge of education policy and funding in their municipalities. We had one quite large municipality with multiple schools, one smaller municipality with a single school and other smaller municipality with a Finnish and Swedish school. Obviously these interviews represent opinions of only few individuals and they should be considered accordingly. The following excerpts are informally translated by the authors.

1. *"The whole sum that is given to the municipality goes towards high school education, at least here in […]. I know municipalities where it does not."* (Respondent A)
2. *"In another municipality where I was, we got more state funding than we used for education."* (Respondent C)
3. *"Yes, municipalities do have some freedom in how they use state grants according to their needs – money is not earmarked. They could for example take from high school education and build roads. This however does not happen."* (Respondent B)
4. *"State grants do not anyway cover all the high school expenses…"* (Respondent B)
5. *"[…] however I do know some smaller municipalities where there is a more direct relationship between the state funding and the amount of how much is spent on education. We do not have so direct link, our budget here won't function so that it's just what we get from state and that's it […]"* (Respondent A)
6. *"[…] many times we are asked that do they meet each other – the amount we get from state and whether it is equivalent to the amount we spend on education, so that this incidence is sort of a problem for us."* (Respondent C)
7. *"I imagine that larger municipalities might have some incentives to use the high school funding more efficiently by merging school etc., but smaller municipalities do not have this kind of leeway."* (Respondent B)
8. *"[…] I don't know whether we add anything from our own money to state grant for high school education. Just for the sake of interest, should actually work out the numbers and see whether the state grant is enough. I don't know have we ever even separated the high school expenditures from the other education spending."* (Respondent C)
9. *"[…] if we then see this from the municipality's side, sure, municipality or organizer itself of course decides how much funding it ultimately puts in, regardless of the amount of state funding […]"* (Respondent A)

The above excerpts vividly illustrate that spending practices among municipalities do differ. In certain places the incidence between spending and grants seems less pronounced than in others (1., 2., 4., & 5.). It is also striking that incidence is not necessarily always known even by the municipalities themselves (6. & 8.). This is not necessarily surprising as effectively high school grants go to the same municipal budget than any other source of income. Thus it may be that the incidence of grants and spending is difficult to judge from the total budget (8.). There also seemed to be understanding of the general purpose nature of the funds (3. & 9.). Respondents also commented that the current system where organizers have the leeway to decide over funding is preferred to a system that would give money more directly to schools. According to them, the latter system would unnecessarily restrict the discretionary decision making abilities of municipalities since they know better at the local level the exact costs of running each individual schools.

AP9 DATA DESCRIPTION APPENDIX

General description and sources

Our raw data combines two main sources of data. The data on high schools comes from the National Board of Education funding data repository (see link below). This data is annually collected and it forms the basis of the state grant funding system. From the repository, we utilize the cost data of high schools, which includes the realized costs and the allocated grants, both in per student terms. The basis of the allocated grants is the number of students in each fall of the schooling year, as described in the paper. This information can also be found from the repository. The raw data covers all organizers of high school education (municipal, private, and joint municipal organizers) except for the practice schools that operate under universities. The original monetary values are in nominal values. Thus we deflate them to values of 2014 using the public sector expenditure index for education sector provided by Statistics Finland. The municipal level variables on the number of high schools, socio-economic characteristics, and election outcomes are provided by Statistics Finland. The municipal level monetary variables have been deflated to 2014 values with the public sector expenditure index for administrative costs, except for the social and healthcare costs, for which we have used the public sector expenditure index for social and health care sector.

The sources for the raw data:

- The high school funding data page is at: https://vos.oph.fi/rap/
  - We use the high school ("Lukiokoulutus") cost tables at organizer level (table label K06G60) which lists expenditures and grants and the corresponding number of students. Here the link uses year 2013 as an example: https://vos.oph.fi/rap/kust/v13/raportit.html

- The municipal level data come from various tables of Statistics Finland.
  - Main source is the municipal finance and operations tables for years 1975-2014 at: http://pxnet2.stat.fi/PXWeb/pxweb/fi/Kuntien_talous_ja_toiminta/?rxid=0cc7f15a-1506-4b71-8f24-f4c8998721f4
    - Note that tables above are not updated anymore and new versions of the tables have been gathered from 2015.
  - Municipal election data comes from: http://www.stat.fi/til/kvaa/index.html
- The number of students comes from the statistics portal of National Board of Education, but the original source also for this database is Statistics Finland. https://vipunen.fi/fi-fi
- The public sector cost indices are from: http://www.stat.fi/til/jmhi/

Additional remarks

The above sources concern the raw data. For the final data we have made some minor corrections concerning for example the temporal inconsistencies in the number of high schools for certain organizers. The final data is available by request from authors. The restrictions applied to get the used estimation sample are described in the paper. Recall that we concentrate only on municipal organizers. Moreover our estimation strategy limits sample size as only a subset of observations is used by the methodology.

References in the Appendix

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