The Organizational Economics of School Chains

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Although autonomy in education is being advocated by academics and promoted by policy makers as a tool to improve standards, a growing number of countries is experiencing a counterbalancing trend: the rapid emergence of 'chains' which bind schools together into institutionalised structures with varying degrees of centralisation. This is for example the case of the US, Sweden and England – three countries that pioneered the delivery of state education through autonomous schools – where a growing number of charters, firskolor and academies (respectively) are joining school chains and networks. Yet, despite their prevalence, very little is known about the structure and the organization of such chains. Discussions among practitioners and in the media often compares these set-ups to private companies with central head-quarters taking most of the key decisions in terms of education strategies and schools simply delivering teaching – not unlike production plants. However, like in the world of business, chains are unlikely to be monolithic structures characterised by uniformly centralised organizational arrangements. Conversely, strategic decision-making is likely to be in the hands of the actors capable of brining the biggest 'benefits' to the organization. In the case of school chains, these benefits are likely to be higher education standards (without over-shooting in terms of costs) – which should attract higher student numbers, and therefore revenues, making organizations viable and financially sustainable.[1]

In our research, we investigate these issues by analysing data on English academy chains – known as multi-academy trusts (MATs) – and by using the lenses of the organizational economics of the firm. In particular, we borrow the following key insights. The choice of the 'board' – i.e., the entity with which responsibility for performance of the chain ultimately rests – to delegate key decisions to school head-teachers – i.e., the practitioners on the ground delivering teaching alongside their staff – is likely to be characterised by the same trade-offs identified by the literature that uses incomplete contracts to study the internal organization of the firm. Specifically, when the principal has limited information and decides to delegate decision-making to the agent there can be benefits: decentralising incentivises the agent to acquire more information about the best course of action (an 'initiative effect'). Alternatively, delegating simply transfers decision making to the actor who is likely to have better information about what to do (an 'information endowment' effect) – i.e., how to run properly the school and turn it around (if needed). However, there can be costs – mainly in the form of a 'loss of control'– because the agent might choose to use his/her information advantage to choose actions/projects that do not line up with the strategies preferred

[1] Sweden and the UK operate a system in which money follows pupils and so pupil roll is an important determinant of school resources. Charter schools in the US are similarly paid a 'charter fee' per pupil enrolled (not dissimilar to a voucher) also creating a tight link between student numbers and funding. It should also be noticed that in Sweden and the US chains can be run 'for profit' while this is not the case in the UK.

by the principal. For example, he/she might chose to expand school roll – irrespective of its impact on education standards, resources and the chain viability. Grossman and Hart (1986) and Aghion and Tirole (1997) provides an early formalisation of this problem, while Acemoglu et al. (2007) adapt it to the context of information diffusion and technology adoption. Our contribution is to make use of the tools developed in this literature to study the internal organization of schools chains *seen as firms*.

Such frameworks provide a number of sharp predictions that can be taken to the data. First, a higher degree of congruence in preferences between the principal and the agent increases decentralisation because it reduces the chances that 'loss of control' will result in an agent's actions that go against the principal's objectives. Second, when the amount of public information available to the principal is limited so that he/she cannot identify the 'right technology' to deliver the best education standards, decentralisation is more likely to occur. Paraphrasing Acemoglu et al. (2007), such cases tend to prevail when: *i*- the chain operates schools that are close to the education technology frontier because the principal (i.e., the board) cannot use other schools' experience to guide decision-making (while publicly available, this information is likely to reflect inferior technological choices); *ii*- the chain operates in heterogeneous environments because such heterogeneity makes it difficult to learn cutting-edge education technologies from other schools' experiences; and *iii*- the chain is young and so has yet to identify its needs and develop the capacity to adapt other education technologies to its objectives.

In order to test these predictions, we use detailed survey information on the decentralisation decisions of procurement activities (for example, in terms of curriculum, teaching equipment, and staff pay-and-contracts management) for 410 academy school chains (i.e., MATs) out of approximately 740 chains managing at least two schools that existed in 2006.[2] Approximately 2,000 schools are part of the MATs in our sample. While the chains we analyse are not representative of the whole population, they are amongst the biggest and the most complex in terms of the traits of the associated schools – and so more likely to have paid due attention to the possible costs and benefits of the decentralization of such activities. Using the precise data contained in the survey, we create a binary indicator that identify chains as 'decentralised' if more than 50% of their procurement activities are delegated to the schools that are part of the network. However, we experiment with different indicators – including a continuous measure of 'decentralisation intensity' obtained by aggregating and standardizing delegation along the various aspects covered by the data.[3]

We augment these data with information obtained from school and pupil censuses over a number of years so that we can measure several detailed characteristics of the chains and their schools, as well as the attributes of all other schools in the Local Authorities (LAs) in which they operate – i.e., the education markets in which they compete and set of competitors from whom they could learn 'best technology'

[2] The data was initially collected by BESA (British Educational Suppliers Association), which works with education providers to assist their procurement facilities. The data is highly reliable and the response rate to the original survey was close to complete.

[3] Note that in the original data, procurement activities can be either delegated to the school, or jointly managed or centrally controlled by the board. In our analysis, we mostly code these three outcomes as 1, 0.5 and 0, respectively.

practices. Using this complex set of data, we construct the following proxies that we use to test the validity of insights of the organizational economics of firms applied to school chains. First, we track the professional background of the members of the chain board, and classify chains as mainly run by 'businessmen and economists', 'educationalists' or 'mixed background'.[4] We then use information on the educational background of the head-teacher to identify whether he/she was trained in economics/business or education/psychology – and identify a measure of 'preference coherence' on the basis of the affinity between head-teacher's training and board orientation. Previous evidence on the effects of preference congruence has mainly used proxies based on trust in the regions of origin of principal and agents (see Bloom et al., 2012). While an important step in the right direction, we believe our measure is a substantial improvement on previous efforts as it captures more directly the likely alignment in terms of objective and teaching philosophy between boards and school leadership – thus relating in a more straight forward way to the underlying theory. Second, we use detailed data on pupil test-score value-added aggregated at the school level to measure the 'technology frontier' of the LAs in which the chain operates (i.e., the 99th of the LA-specific value-added distribution) as well as the average productivity of the schools within the MAT. While levels of achievement are heavily influenced by factors other than a school's contributions – such as family background, ethnic origins and gender – value-added measures are widely accepted in the education literature as (relatively) good proxies for 'productivity' and for the input a school makes to its students' learning. Using this information, we construct chain specific measures of distance to the technological frontier based on the relative position of its school productivity compared to the 'markets' in which it operates. We also construct a proxy for the heterogeneity of the environment in which the school chain is operating by looking at the spread between the 10th and the 90th percentiles of the test-score value-added distribution of the LA in which the trust operates. Finally, we identify the age of the chain by using the date in which the first school joined (measured in months from September 2016 when the survey was collected) and – following Acemoglu et al. (2007) – we classify MATs using dummies that identify the age quartile to which they belong (25% youngest; 25%-50%; 50%-75%, 75% oldest MATs).

One possible concern with our analysis is that, while we are interested in capturing the relationship between certain chain's characteristics and the decision to decentralise decision-making, we might capture an association that runs in the opposite direction – i.e., from decentralisation to characteristics. Although our study has no causal-identification ambition – it aims to be the first exploration of the applicability of organizational economics to school chains – we mitigate such issues by mainly measuring school and MAT characteristics in 2009. This date is prior to the time when a set of policies implemented in 2010 by a newly elected Government paved the way for a swift expansion of school chains in the English education system. To provide some context, on average eight school chains opened between 2003 and 2009 (there were no MATs before the academic year 2002/2003) leading to a total number of 56 chains in 2009. However, 41

[4] Some of this information was contained in the original BESA survey. However, we filled missing gaps and checked some of the original records using UK Companies House. This is a Government maintained site where all companies – including MATs – have to register their details and the characteristics of their board (e.g., name, family name, date of appointment and background).

MATs opened in the academic year 2009/2010 – even if only the last few months of the year were actually affected by the new Government policy. Furthermore, in the three subsequent years (2010/2011, 2011/2012 and 2012/2013) an average of nearly 160 chains opened per year – with more than 210 in 2010/2011 alone (see Figure 1 for more details). While the take-off slowed down somewhat in the last three years covered by our data (up to 2016), the average number of openings was still approximately 70 per year. Consistently, we find that only around 4% of the nearly 2,000 schools in our chains had already joined the organizations by 2009 – while nearly 75% of them joined between 2012 and 2015. In short, focussing on MAT and school attributes measured in 2009 helps our empirical analysis for two reasons. First, we are likely to capture associations that run from characteristics determined before schools joined the MAT to the decision of the school chain to decentralise decision-making in 2016 – as opposed to the other way around. Second, we are also likely to measure characteristics that are 'exogenous' to schools' decisions to join chains – or the chains' decisions to take over large number of schools – as the policies that led to the rapid increase in pervasiveness of networks and 'urged' large numbers of schools to join were unexpectedly introduced in June 2010. Nevertheless, since measuring our proxies seven years before the decisions to decentralise activities are taken can introduce measurement error, we experiment with alternatives based on characteristics captured in 2015.

In a nutshell, our evidence shows that the insights of the organizational economics of firms have broad applicability to the decentralisation of decision-making of school chains. First, we find that a one standard deviation increase in the share of schools within the MATs whose leadership background is aligned with the board 'philosophy' increases the probability of decentralisation by approximately 10%. This result is significant and robust to a number of specification checks. Second, we estimate that a one standard deviation increase in the distance between the LA value-added (productivity) 'frontier' and the average productivity of the schools in the chain decreases the chances of decentralisation by up to 13%. However, we find no association between the heterogeneity of the school value-added productivity of the markets in which the chain operates and its decision to delegate. As this finding runs counter previous firm-related evidence, we subjected it to several tests – for example, by measuring market heterogeneity using final attainment (i.e., in levels as opposed to value-added), by considering value-added productivity growth averaged over three years, and moving our measurement window closer/further to when MATs take their decentralisation decisions. None of these checks changed our conclusions. Lastly, we find that younger chains are significantly more likely to decentralise activities. For example, MATs in the bottom 25% of the age distribution (on average 22-month old) are 65% more likely to decentralise than those in the top 25% (92-month old or nearly 8 years). This effect shrinks to approximately 49% for MATs with ages in the 25%-to-50% age distribution bracket and to zero for those in the 50%-to-75% interval – revealing that the impact of age is very non-linear.

We also investigate whether these results hold when we study the various activities on which the chain could delegate control to the schools in the network. Broadly speaking, we find that our core evidence is confirmed. However, we also find that the effect of distance to the productivity frontier is more marked

for items more likely to be directly related to students' learning – such as assessment, curriculum development, career-and-development schemes and teaching equipment – and less so to staffing issues (mainly, contract writing and legal management). A very similar pattern emerges when we consider the alignment of preferences between the chain board and the school managerial team. Conversely, the impact of (young) age is more prominent for ICT-related procurement activities, utilities and staffing issues – although the patterns for the other items (in particular for curriculum and assessment) broadly confirm our main findings.

Our work relates to previous studies that have analysed management practices in schools and universities, and studied their associations to students' outcomes, teaching quality and research performance (see for example, Bloom et al., 2014; Di Liberto et al., 2014 and McCormack et al., 2013). However, we are the first to draw directly from the theoretical literature on the organization of the firm to study the internal structure of school chains – a new, but increasingly prevalent institutional set-up in the delivery of state education. Future work will investigate the link between the structures of school chains and their students' performance, and provide a consolidated framework to think about the trade-offs faced by chains when delegating decision-making and choosing their optimal internal structure.

References

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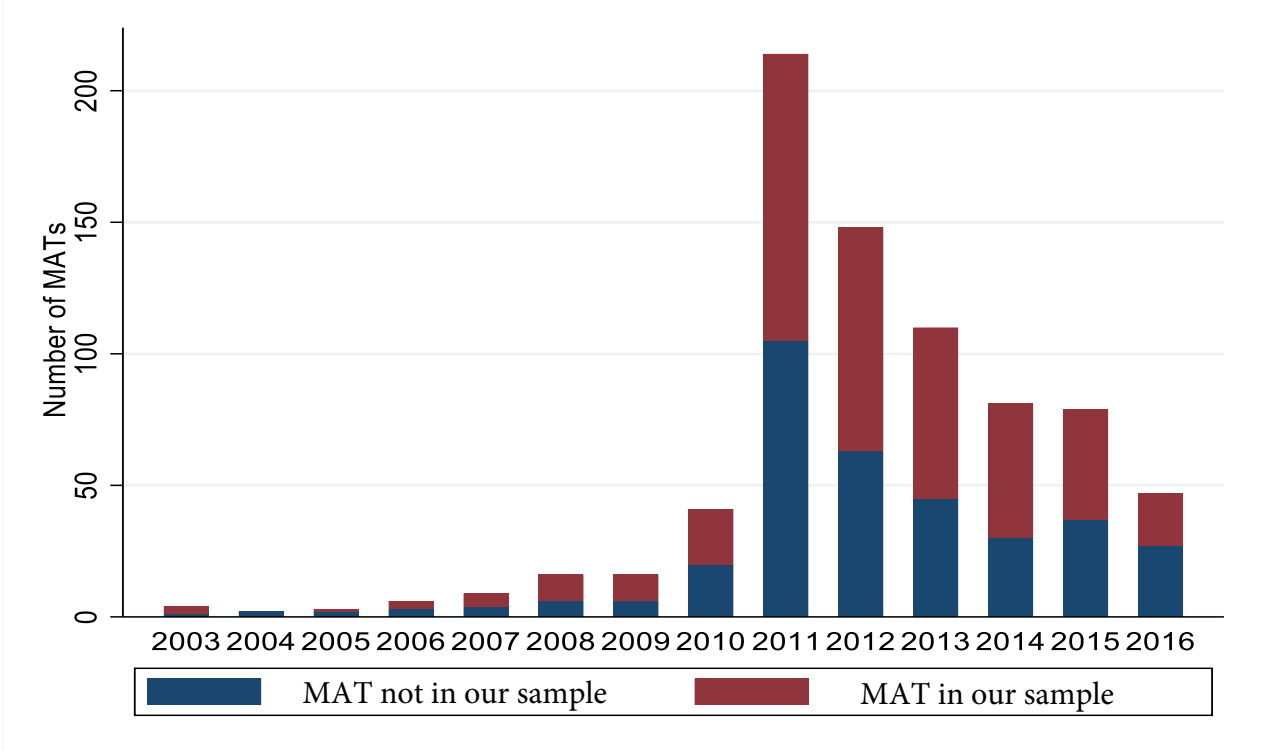
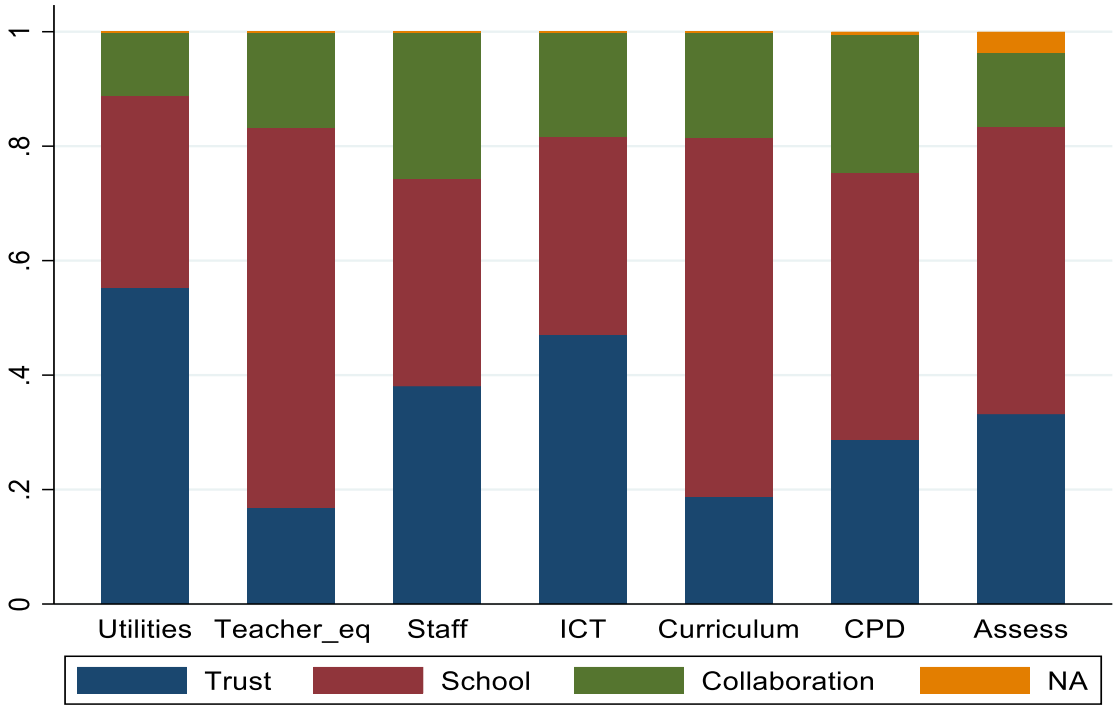
Figure 1: Number of MATs opening by year



Note: based on the academic year in which the first school of the MAT joins the organization. No MATs before the academic year 2002/2003.

Figure 2: Procurement and distribution of roles within MATs - by surveyed items



Note: data available for 410 MATs in our sample. However, number of observations varies depending on the specific item. Information on procurement and decentralisation of facilities maintenance is not tabulated due to insufficient number of observations

Table 1: Descriptive statistics

	Mean	SD	Min	Max
Panel A. School characteristics				
Percentage of FSM eligible students	19.4	13.2	0.0	71.0
Percentage of White students	79.8	23.7	0	100
Percentage of SEN students	16.8	8.2	0.6	61.7
Percentage of English-natives speakers	82.6	21.2	0.0	100.0
Number of students	447.7	344.4	21.0	2447.0
Observations	1923	1923	1923	1923
Panel B. LA characteristics				
Percentage of primary schools	76.8	8.8	27.7	86.8
Percentage of secondary schools	19.0	8.0	10.0	66.0
Percentage of community schools	41.0	13.2	10.5	75.0
Percentage of volutary aided schools	18.6	11.2	0.0	55.1
Percentage of sponsor-led academies	6.9	5.2	0.0	26.3
Percentage of converter academies	16.1	12.1	0.0	58.3
Percentage of academies	23.0	14.5	2.9	69.4
Observations	145	145	145	145
Panel C. MAT characteristics				
Decentralisation	0.541	0.499	0.000	1.000
Age (months)	47.2	23.9	1.0	155.0
Distance to frontier - Value Added (2009)	0.793	0.301	0.000	2.941
Distance to frontier - Value Added (2015)	0.748	0.277	0.000	1.956
Heterogeneity - Value Added (2009)	1.384	0.630	0.602	3.608
Heterogeneity - Value Added (2015)	1.218	0.534	0.512	4.065
School and MAT board alignment (2009)	0.109	0.208	0.000	1.000
Board alignment information imputed (2009)	0.311	0.322	0.000	1.000
School and MAT board alignment (2015)	0.147	0.236	0.000	1.000
Board alignment information imputed (2015)	0.175	0.280	0.000	1.000
Percentage of economics/business trust boards	71.1	45.4	0.0	100.0
Percentage of trusts with imputed governance type	32.0	46.7	0.0	100.0
Herfindahl index of geographical dispersion	0.833	0.267	0.054	1.000
Percentage of academy converter	59.2	31.9	0.0	100
Percentage of primary schools	65.6	34.9	0.0	100
Percentage of secondary schools	30.1	32.3	0.0	100
Percentage of FSM eligible students	17.4	10.0	1.8	59.7
Percentage of White	77.6	23.1	0.0	99.2
Percentage of SEN students	16.6	6.6	4.8	48.7
Percentage of males	51.0	7.0	0.0	94.0
Percentage of English-native speakers	82.1	19.4	2.4	99.6
Percentage of managers with a business degree	2.6	5.2	0.0	33.3
Number of students	2245.8	3101.4	218.0	30524
Size (number of schools in MAT)	5.0	6.2	1.0	55
Observations	410	410	410	410

Note: sample only include primary, secondary and all through non-special schools in England. Special schools and middle schools not included. FSM: free school meals; SEN: special education needs. Top panel considers descriptives at the school level including only schools that are part of the 410 MATs in our sample. The central panel presents descriptive statistics at the Local Authority level including all schools in the LA. The bottom panel presents descriptive statistics at the MAT level. Decentralised is equal to one if the average of the various items on procurement/decentralisation questions is above 0.5. The original variables are coded as zero if the MAT holds responsibility, 1 if the school is in charge and 0.5 if there is joint management. Age (months) consider the date of entry of the first school to join the MAT. Distance to frontier measures the distance between a school value-added and the 99th percentile of the value-added distribution in the LA where the school operates averaged within the MAT. Heterogeneity measures the difference between the 90th percentile and the 10th percentile in the value-added distribution in the LA in which the schools operate averaged within MAT. School and MAT board alignment based on the educational background of the headteacher and the school managerial team compared to the specialism of the board of the MAT (business/economic vs. educationalist vs. mixed). For some MAT this information is missing due to missing school/board data. Some of the information that was missing in the original survey about the MAT board specialism has been imputed using UK Companies House register data. See body text for more details. Herfindahl index based on the shares of schools in the MAT that are located in different local authorities.

Table 2: Main results

	Decentralization			
VARIABLES	(1)	(2)	(3)	(4)
Distance to frontier - Value Added (2009)	-0.212***		-0.245***	-0.245***
	(0.075)		(0.078)	(0.078)
Average School Value Added (2009)		0.123		
		(0.125)		
Frontier, 99th Percentile of Value Added (2009)		-0.258***		
		(0.086)		
Heterogeneity - Value Added (2009)	-0.046	-0.043	-0.035	-0.027
	(0.039)	(0.039)	(0.039)	(0.041)
Age < 25th percentile	0.210**	0.220**	0.357*	0.347*
	(0.087)	(0.087)	(0.183)	(0.184)
25th < Age < 50th percentile	0.160*	0.167*	0.272**	0.265*
	(0.091)	(0.091)	(0.136)	(0.136)
50th percentile < Age < 75th percentile	-0.040	-0.035	-0.010	-0.014
	(0.089)	(0.089)	(0.115)	(0.116)
School and MAT board alignment (2009)	0.213*	0.223*	0.271**	0.275**
	(0.121)	(0.124)	(0.130)	(0.133)
Board alignment information imputed (2009)	-0.030	-0.035	-0.024	-0.029
	(0.079)	(0.079)	(0.080)	(0.080)
Trust type - imputed values	0.007	0.007	0.007	0.006
	(0.052)	(0.052)	(0.053)	(0.053)
Trust type (economics/business type)			-0.007	-0.006
			(0.052)	(0.052)
Percentage of academy converter (×100)			0.160*	0.163*
			(0.097)	(0.098)
Percentage of primary schools (×100)			-0.297**	-0.298**
			(0.116)	(0.118)
School chain controls	N	N	Y	Y
Student demographic controls	N	N	Y	Y
Marekt level (LA) controls	N	N	N	Y
Observations	410	410	410	410
R-squared	0.067	0.069	0.118	0.121

Note: Variable description and key statistics in Table 1. School chain controls include: average number of months since the school joined the MAT (school age, in months); standard deviation of school age within the MAT; average number of students in the school levels in the network; standard deviation of the number of school students within the MAT; standard deviation of school value-added within the MAT; MAT size (total number of schools); total number of pupils in the MAT; Herfindahl index (share of schools in different LAs); dummy for MATs with only one school. Student demographic controls include: percentage of White students; percentage of FSM eligible students. Market level (LA) controls include: share of primary schools; share of community schools; share of sponsored academies; share of converter academies. F-stat (P-value) on the test that Average School Value Added (2009) and Frontier, 99th Percentile of Value Added (2009) are the same: 0.92 (0.3368). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Determinants of decentralisation: Robustness checks

	Standard measure decentralisation					Alternative measures of decentralisation	
						Collaboration recorded	Continuous measure of decentralisation
	Alignment measured in 2009	Alignment measured in 2009	Alignment measured in 2009	Alignment measured in 2015	Alignment measured in 2015	Alignment measured in 2015	Alignment measured in 2015
	Imputed missing	Imputed missing	No imputed missing	Imputed missing	No imputed missing	Imputed missing	Imputed missing
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Distance to frontier - Value Added (2009)	-0.230***	-0.211***	-0.204**	-0.249***	-0.208**	-0.248***	-0.369**
	(0.080)	(0.073)	(0.097)	(0.078)	(0.093)	(0.078)	(0.172)
Heterogeneity - Value Added (2009)	-0.008	-0.059	-0.013	-0.023	-0.021	-0.002	0.021
	(0.043)	(0.041)	(0.043)	(0.040)	(0.041)	(0.040)	(0.085)
Age < 25th percentile	0.293	0.319*	0.425**	0.341*	0.441**	0.408**	0.718**
	(0.189)	(0.181)	(0.191)	(0.185)	(0.188)	(0.188)	(0.361)
25th < Age < 50th percentile	0.244*	0.191	0.306**	0.254*	0.289**	0.277**	0.491*
	(0.137)	(0.133)	(0.140)	(0.136)	(0.138)	(0.138)	(0.261)
50th percentile < Age < 75th percentile	-0.033	-0.046	-0.014	-0.015	0.003	0.036	0.002
	(0.117)	(0.112)	(0.118)	(0.117)	(0.118)	(0.116)	(0.226)
School and MAT board alignment	0.284**	0.324**	0.178*	0.268**	0.225**	0.316***	0.515**
	(0.140)	(0.128)	(0.094)	(0.116)	(0.101)	(0.115)	(0.232)
Alignment information imputed	-0.034	0.018		0.019		0.051	-0.201
	(0.094)	(0.078)		(0.095)		(0.096)	(0.200)
Trust type - imputed values	0.004	-0.021	0.009	0.002	0.015	0.018	0.055
	(0.056)	(0.051)	(0.057)	(0.053)	(0.056)	(0.053)	(0.111)
Trust type (economics/business type)	0.012	0.011	0.001	0.002	0.003	0.039	-0.120
	(0.054)	(0.051)	(0.056)	(0.053)	(0.056)	(0.054)	(0.110)
Percentage of academy converter (×100)	0.183*	0.133	0.167	0.177*	0.195*	0.222**	0.366*
	(0.105)	(0.097)	(0.102)	(0.097)	(0.100)	(0.097)	(0.203)
Percentage of primary schools (×100)	-0.313**	-0.172	-0.237*	-0.300**	-0.281**	-0.325***	-0.541**
	(0.126)	(0.116)	(0.126)	(0.117)	(0.120)	(0.114)	(0.242)
Additional controls for teacher characteristics	Yes	No	No	No	No	No	No
Additional controls for "top slice"	No	Yes	No	No	No	No	No
Observations	385	399	371	410	383	410	410
R-squared	0.123	0.206	0.118	0.122	0.124	0.114	0.121

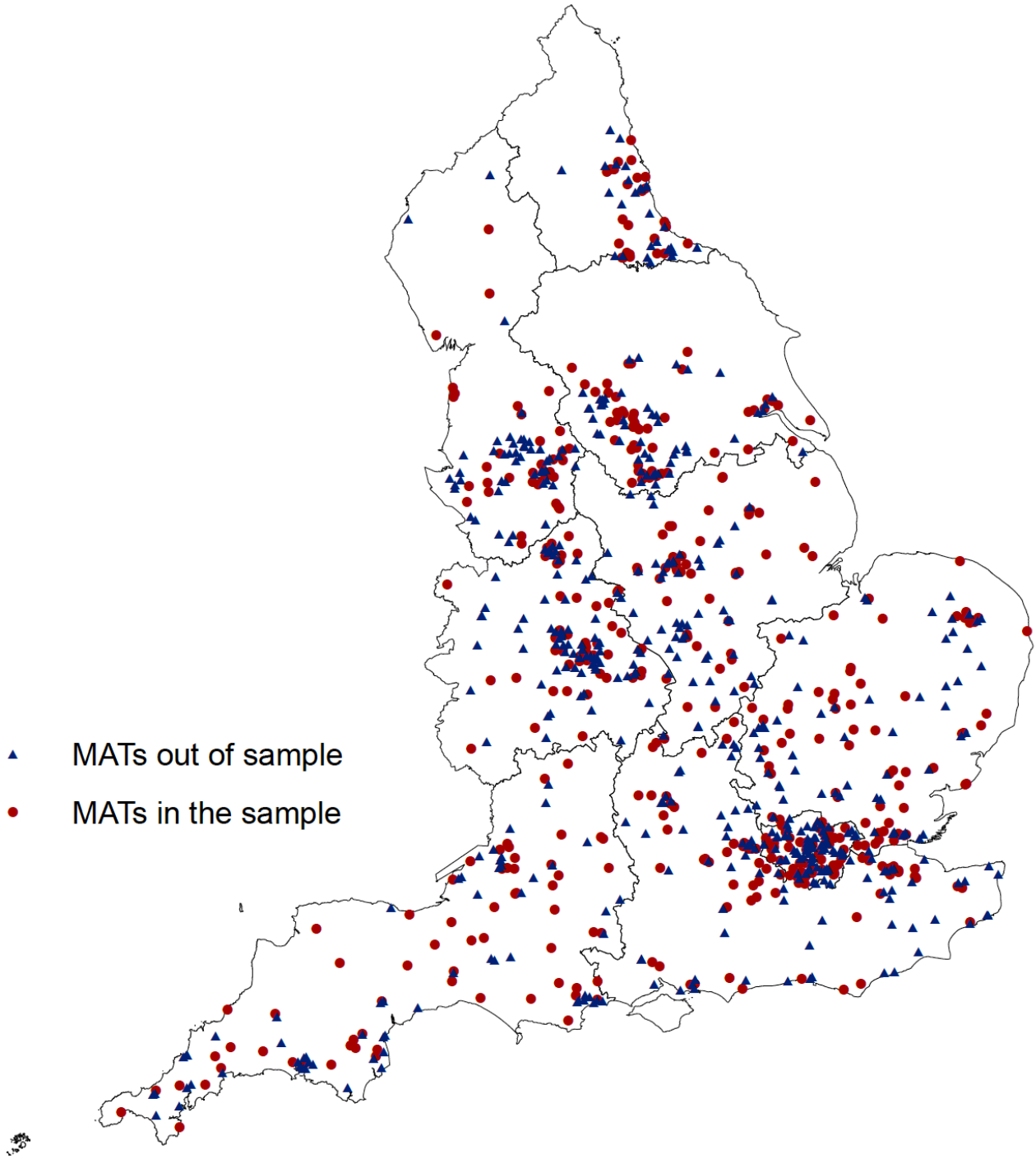
Note: Variable description and key statistics in Table 1. Specifications include school chain controls; student demographic controls and market level (LA) controls. See Table 2 for details. Additional teacher controls include: school pupil-to-teacher ratio; total number of teachers at the school; number of teachers on school managerial team. Additional control for MAT financing include: chain uses "top slicing" (yes/no); "top slicing" information is missing; "top slicing" fixed or variable. Columns (3) and (5) do not impute missing values (to zeros) for the school and MAT board alignment variable. Column (6) recodes school/MAT collaboration in procurement as zero (centralised). Column (7) uses decentralisation intensity measured as the sum of the decentralisation variable for all the different items (namely assessment, career and personal development, ICT, curriculum, teaching equipment, staffing matters and school utilities) standardized to have mean zero and unitary standard deviation. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Main predictors of decentralisation by type of service

VARIABLES	Disaggregate services							Aggregate services		
	Assess	CPD	ICT	Curriculum	Teaching equipment	Staff	Utilities	Teachers	Students	Infrastracture
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Distance to frontier - Value Added (2009)	-0.171**	-0.190**	-0.139*	-0.198**	-0.231***	-0.066	-0.161**	-0.048	-0.152*	-0.188**
	(0.081)	(0.081)	(0.074)	(0.077)	(0.074)	(0.078)	(0.074)	(0.075)	(0.079)	(0.075)
Heterogeneity - Value Added (2009)	0.019	0.015	0.003	0.016	0.033	0.019	0.017	0.024	0.036	0.005
	(0.043)	(0.041)	(0.039)	(0.042)	(0.039)	(0.040)	(0.038)	(0.038)	(0.043)	(0.039)
Age < 25th percentile	0.250	0.158	0.302*	0.166	0.098	0.451***	0.422**	0.259	0.211	0.489***
	(0.196)	(0.197)	(0.166)	(0.173)	(0.161)	(0.172)	(0.183)	(0.168)	(0.193)	(0.181)
25th < Age < 50th percentile	0.175	0.081	0.157	0.171	0.054	0.325**	0.253*	0.165	0.164	0.311**
	(0.144)	(0.147)	(0.124)	(0.127)	(0.118)	(0.128)	(0.134)	(0.126)	(0.141)	(0.133)
50th percentile < Age < 75th percentile	-0.005	-0.063	0.033	0.013	-0.111	0.160	0.098	0.049	-0.006	0.162
	(0.122)	(0.122)	(0.105)	(0.111)	(0.102)	(0.104)	(0.106)	(0.103)	(0.119)	(0.107)
School and MAT board alignment	0.269**	0.228*	0.182	0.230**	0.184*	0.045	0.165	0.127	0.228**	0.111
	(0.122)	(0.120)	(0.113)	(0.112)	(0.105)	(0.119)	(0.106)	(0.115)	(0.113)	(0.110)
Alignment information imputed	0.012	-0.042	-0.055	-0.054	-0.012	-0.157*	-0.035	-0.125	-0.036	-0.060
	(0.094)	(0.099)	(0.091)	(0.094)	(0.092)	(0.090)	(0.094)	(0.086)	(0.096)	(0.095)
Trust type - imputed values	-0.009	0.068	0.046	0.009	0.013	0.042	0.035	0.076	0.010	0.023
	(0.056)	(0.054)	(0.053)	(0.052)	(0.051)	(0.053)	(0.052)	(0.051)	(0.053)	(0.054)
Trust type (economics/business type)	-0.030	-0.004	-0.003	-0.023	0.010	-0.070	-0.046	-0.074	-0.057	-0.008
	(0.056)	(0.057)	(0.053)	(0.053)	(0.052)	(0.054)	(0.054)	(0.052)	(0.055)	(0.054)
Percentage of academy converter (×100)	0.214**	0.060	0.133	0.118	0.149	0.239**	0.190**	0.120	0.298***	0.171*
	(0.100)	(0.100)	(0.095)	(0.095)	(0.095)	(0.095)	(0.092)	(0.093)	(0.098)	(0.096)
Percentage of primary schools (×100)	-0.278**	-0.190	-0.075	-0.226*	-0.166	-0.168	-0.124	-0.131	-0.307***	-0.185
	(0.118)	(0.117)	(0.106)	(0.115)	(0.111)	(0.114)	(0.107)	(0.102)	(0.114)	(0.113)
Observations	395	408	409	409	409	409	409	410	410	410
R-squared	0.091	0.075	0.086	0.092	0.103	0.073	0.104	0.071	0.102	0.118

Note: Variable description and key statistics in Table 1. Specifications include school chain controls; student demographic controls and market level (LA) controls. See Table 2 for details. Decentralisation of teaching activities is a dummy equal to one if the average of teaching equipment and staffing matters is above 0.5, and zero otherwise. Decentralisation of teaching activities is a dummy equal to one if the average of assessment and curriculum is above 0.5, and zero otherwise. Decentralisation of infrastructure activities is a dummy equal to one if the average of ICT, teaching equipment and utilities is above 0.5 and zero otherwise. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Figure 1: The Spatial Distribution of School chains - in and out of our sample



Note: based on the authors' calculations using MAT headquarters' address (postcode). Solid lines refer to Government regions.

Appendix Table 1: Comparison between MATs included and excluded from the final sample

	Mean (final sample)	Mean (excluded sample)	Difference
Size (number of schools in MAT)	5.038	2.476	2.562***
			(0.324)
Number of students	2271.3	1215.2	1,056.1***
			(162.156)
Percentage of primary schools	65.948	81.436	-0.155***
			(0.022)
Percentage of converter academies	59.650	71.847	-0.122***
			(0.025)
Herfindahl index	83.299	92.773	-0.095***
			(0.016)
Percentage of FSM studnets	17.252	15.606	0.016**
			(0.008)
Percentage of White students	77.656	78.135	-0.005
			(0.017)
Percentage of SEN students	16.516	14.734	0.018***
			(0.005)
Percentage of English-native speakers	82.203	84.247	-0.020
			(0.014)
Percentage of males	50.897	50.795	0.001
			(0.006)
Average number of students per school	483.5	580.5	-97.001***
			(22.697)
Value added, measured in 2015	1.394	0.032	1.362***
			(0.016)
Percentage of schools judged outstanding by Ofsted	17.580	16.041	1.539
			(1.569)
Percentage of schools judged good by Ofsted	40.732	33.137	7.595***
			(2.223)
Percentage of schools judged requirying improvements by Ofsted	12.131	7.041	5.090***
			(1.195)
Percentage of schools judged failing by Ofsted	4.877	2.927	1.950**
			(0.795)
Percentage of Ofsted inspections NA	24.678	40.856	-16.178***
			(2.487)
Age (months)	47.1	47.2	-0.075
			(1.858)
Observations	425	351	776

Note: see Table 1 for variable descriptions. Last column presents results from a mean-difference test between columns (1) and (2) with robust standard errors. *** p<0.01, ** p<0.05, * p<0.1