The Organizational Economics of School Chains*

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Abstract: We use the insights of the organizational economics of firms to study the organization of school chains. We match information on decentralization of activities for approximately 400 chains and 2,000 schools in England to student- and school-level administrative records. Chains with a larger share of schools whose leadership background is aligned with the chain expertise, younger chains, and chains close to the productivity frontier decentralize more. We also investigate the link between chain decentralization and average school performance – but find no significant association. However, this headline finding masks important heterogeneities, with weaker schools within chains losing out from decentralization.

Keywords: School chains; school autonomy; organizational economics; incomplete contracts.

JEL codes: I2; L2; D8.

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1. Introduction

While autonomy in education is increasingly advocated as a tool to improve standards, a growing number of countries is experiencing a counterbalancing trend: the emergence of 'chains' that bind schools together into institutionalised structures with varying degrees of centralisation. This is the case for the US, Sweden and England: although the three countries pioneered the organization of state education around autonomous schooling, a growing number of self-governed charter schools, friskolor and academies are part of chains. In England, this trend is especially marked: as of Summer 2021, approximately 36% of primary and 60% of secondary schools were part of a chain – enrolling more than 3.5 million students. The latest Government White Paper (March 2022) – setting out the official education policy agenda – envisions that all schools will be part of a network by 2030.

Despite their prominence, little is known about the organization of school chains. Discussions among practitioners and in the media often compare them to private companies with central head-quarters taking most of the strategic decision-making away from schools – with the latter simply delivering teaching (like production plants). However, as in the world of business, chains are unlikely to be monolithic structures uniformly characterised by centralised arrangements. Conversely, strategic decision-making is likely to be in the hands of the actors capable of delivering the biggest benefits to the organization. In the case of school chains, these benefits are likely to be higher education standards – which in the context of quasi-market for education attract higher student numbers and resources, making organizations financially viable.[1]

In our research, we investigate these issues by analysing data on English academy chains – known as multi-academy trusts (MATs). To inform our investigation, we 'wear the lenses' of the organizational economics of the firm and borrow the following key insights. The choice of the board (i.e., the entity with which responsibility for the chain performance rests) to delegate key decisions to school head-teachers (i.e., the managers delivering education alongside their staff) is likely to be characterised by the same trade-offs identified by the

[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. Note that in Sweden and the US chains can be run for profit, while this is not the case in the UK.

literature that uses incomplete contracts to study the internal organization of firms. On the one hand, when the principal has limited information and decides to delegate decision-making to the agent, there can be benefits: decentralising incentivises agents to acquire more information about the best course of action (an 'initiative effect') or transfers decision making to the actor likely to have better information about what to do (an 'endowment effect'). However, there can be costs – mainly in the form of a 'loss of control': the agents might decide to use their information advantage to choose actions that maximise their benefits, but do not line up with the strategies preferred by the principal. In our context, head-teachers might choose to expand school roll because this positively reflects on their reputation – irrespective of its impact on standards, resources and chain viability. Grossman and Hart (1986) and Aghion and Tirole (1997) provide an early formalisation of this problem, while Acemoglu et al. (2007) adapt it to the context of information diffusion and technology adoption. Our paper is the first to make use of the tools developed in this literature to study the internal organization of school chains *seen as firms*.

Such framework provides several 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 technologies from other schools; and *iii*- the chain is young and has yet to identify its needs and develop the capacity to adapt other education technologies to its objectives.

To test these predictions, we use detailed survey information (collected in the autumn of 2016) on the decentralisation decisions of procurement activities in terms of curriculum, teaching equipment, and pay-and-contract management for approximately 400 chains (roughly 60% of all chains that existed in 2016) and 2,000 schools. These variables are measured at the MAT level as chains codify such procedures through 'schemes of delegation' that normally apply to all schools in the structure. We match these data to web-scraped details about the background of the members of each chain's governing board[2] and information from school, teacher and pupil censuses over a number of years. This allows us to 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 set of competitors from whom they could learn 'best practices'.

Using these data, we construct the following proxies to test the 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'. We then use information on the background of school head-teachers and their local management team to identify whether they were trained in economics/business or education – and identify a measure of 'preference coherence' based on the affinity of the local management team's training and the board orientation. Previous evidence on the effects of preference congruence has used proxies based on trust in the regions of origin of principals and agents (see Bloom et al., 2012). We believe our measure is an improvement on previous efforts as it captures more directly the alignment in terms of objectives and teaching philosophy between chain boards and school leadership.

Second, we use administrative data on pupil test-score value-added aggregated at school level to measure the 'technology frontier' of the LAs in which the chain operates (i.e., the 99th percentile 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 contribution (especially family background), value-added measures are broadly accepted in the education literature as good proxies for school productivity. Using this information, we construct chain-specific measures of distance to the technological frontier based on the relative position of its schools' productivity compared to the markets in which they operate. We also construct several proxies for the heterogeneity of the environment in which the chain operates based on the spread between the top and bottom percentiles of the productivity distribution of the LAs in which the MAT is present. Finally, we identify the age

[2] We constructed these records using UK Companies House. This is a Government-maintained website where all companies – including MATs – have to register their details and the characteristics of their board.

of the chain by using the date in which the first school joined and – following Acemoglu et al. (2007) – we classify MATs using dummies that identify the age quartile to which they belong.

A few remarks are worth making to support our choices in relation to these proxies. First, we use value-added to capture productivity and education 'quality' as in the English context this is associated with parental school preferences and capitalised into house prices (see Gibbons et al., 2013). While at variance with recent US evidence (e.g., Abdulkadiroglu et al., 2020), the English institutional context is different: performance tables present value-added metrics in a salient fashion – and 'progress' is a topic of discussion among parents and practitioners. Second, we focus on attainments as key drivers of a chain's decentralisation decision – implicitly assuming that these are paramount to school choice, pupil roll and thereby schools'/chains' viability. Gibbons and Silva (2011) provide evidence that test-score based measure of school quality dominate parental satisfaction with schools – over and above child wellbeing at school and enjoyment of the learning environment. Of course, it is possible that chains consider broader objectives when choosing their organizational structures. In this respect, our work is a simplification that allows us to 'transfer' the paradigm of the organizational economics of firms to the education context. Our results do show that chains choose their structures in ways that relate to value-added metrics – *ex-post* supporting our choices. Lastly, we identify the markets in which the chains operate as the LAs in which their schools are located. While this is also a simplification, most chains operate in a single LA or a small set of proximate LAs. Moreover, families – especially at the primary school phase (70% of the schools in our sample are primaries) – mainly choose schools from the LA of residence. Therefore, our context supports the idea that the LA is the market in which chains compete to attract children via their education standards.

Although our study has no 'strong identification' claims to make – instead, it aims to be the first exploration of the applicability of firms' organizational economics to school chains – we take several steps to mitigate reverse causality and possible endogeneity concerns. To begin with, we measure school and MAT characteristics in 2009. This date is before the time a set of policies implemented in 2010 by a newly elected Coalition Government paved the way for a swift expansion of school chains in England. Prior to this change, a total of 56 chains opened between 2002 and 2009 (there were no MATs before 2002). In contrast, 45 MATs opened in the academic year 2009/2010 – even if only the last few months of the year were affected by the new policy (June to August). Furthermore, in the three subsequent academic years an average of nearly 160 chains opened every year – with nearly 240 in 2010/2011 alone (see Figure 1). While the take-off slowed down in the last three years covered by our data (up to

2016), the average number of openings was still more than 70 per year. In short, focussing on attributes measured in 2009 is likely to pin down the associations running from pre-determined school features to the decision of the chain to decentralise in 2016 – rather than the other way around.

The rapid policy-driven expansion of the MAT sector also helps identify the impact of characteristics that are exogenous to schools' decisions to join chains (or chains' decisions to take over large number of schools): the reforms that led to the swift increase in pervasiveness of networks were unexpectedly introduced in June 2010 and many schools were 'urged' (to say the least) to join MATs – irrespective of their characteristics. This push was driven by political considerations and a desire of the newly elected centre-right Government to strengthen autonomy and competition in state-education. Nevertheless, it might still be possible that schools selected to join chains (or chains accepted schools) based on attributes that made them more compatible with the MAT organizational structure. For example, more technologically advanced (high value-added) schools could have joined chains with a 'hands-off' (decentralised) reputation – leaving more centralised networks in charge of weaker schools. To by-pass such idiosyncratic-match issues, we replicate our analysis for schools in areas in which chains held a monopolistic position (i.e., only one chain was presented or held a dominant share of the market) and so schools had virtually no choice in terms of which network to join (once they were pushed to do so by Government *fiat*). This approach confirms our main findings.

In a nutshell, we find that the insights of the organizational economics of firms have broad applicability to the decentralisation of decision-making of school chains. We find that increasing the share of schools within the MATs whose leadership background is aligned with the board 'philosophy' significantly increases the probability of decentralisation. Moreover, we find that an increase in the distance between the LA value-added (productivity) frontier and the average productivity of the schools in the chain significantly decreases decentralisation. We find, however, no association between the heterogeneity of the school value-added in the markets in which the chain operates and its decision to delegate. Lastly, we find that younger chains are significantly more likely to decentralise activities – with a non-linear impact of age.

In the second part of the paper, we investigate the link between the structures of school chains and their students' performance. To uncover the causal effect of joining a MAT on attainments, we focus on 'legacy' students who were enrolled at schools before these joined a chain and devise a differences-in-differences (DiD) analysis that compares attainment value-added at the end of primary or secondary school of pupils that: *(i)* start their education in schools that will join a chain within our observation window, but are not exposed to a 'chain treatment'– i.e., they complete their education before the school joins a MAT; *(ii)* start primary or secondary education in schools before they join a chain, but are exposed to up to four years of chain education; and *(iii)* start education in schools that will join a chain after the end of our observation window (our attainment data stop in the academic year 2014/2015). The use of legacy students is similar to the 'grandfathering' method used by Abdulkadiroglu et al. (2016) to study US charter takeovers and has been adapted to investigate the impact of school autonomy in England (see, Eyles and Machin, 2019; Bertoni et al., 2020; and Neri and Pasini, 2020). Given the staggered nature of our treatment – i.e., the time when schools join a chain – we use a stacked-by-event design to deal with the econometric issues highlighted by the recent literature on DiD designs (see for example Goodman-Bacon, 2021).

Using this approach, we find that students' attainments are about 5% of a standard deviation higher once a school joins a MAT. To corroborate our headline findings and methods, we carry out various robustness checks – including an event-study analysis showing that pre-trends in performance are flat. We then use this DiD approach to uncover school-specific estimates of the impact of joining a MAT – and create measures for the average effectiveness of different chains. Our results show that there is considerable variation in the school-specific effect of joining a MAT as well as chain average effectiveness. However, when we relate this variation to our proxies for whether the chain has more/less decentralised decision making, we find limited evidence of significant associations. Stated differently, a chain's organizational structure is not related to the performance of its schools. We argue that this finding is consistent with the insights of the organizational economics of firms we have used to inform our analysis: chains choose their organization in ways that maximize output (i.e., students' learning) on average within the group – so the equilibrium relationship between performance and organizational set-up should be flat. However, our headline results mask some important heterogeneity: weaker schools within the MAT lose out from more decentralized structures. This suggests that while the specific organizational structure adopted by a chain might be optimal at the group level, it has the potential to create 'winners' and 'losers' within the MAT.

Our work relates to a small number of studies that have analysed management practices in schools and universities, and investigated their associations with students' outcomes, teaching quality and research performance (see Bloom et al., 2014; Di Liberto et al., 2014; Dynarski et al., 2018, Fryer, 2014; and McCormack et al., 2013). Closest to our research is a set of papers by Bryson et al. (2018a, 2018b, and 2019) who focus on leadership, human resources (HR) management and performance in English schools. However, we are the first to draw directly from the literature on the organization of the firm to study the internal structure of school chains.

Our results have strong relevance as they speak to ongoing debates about the applicability of quasi-market paradigms in education. Critics of market-oriented reforms (especially in policy circles and among education practitioners) argue that such policies cannot significantly raise standards because 'schools are not firms' – and so tend to react to different motives and in ways that cannot be represented by economic models. Our findings suggest otherwise: under the plausible assumption that a chain's objective is to maximise students' learning (supported by our institutional context), we uncover clear evidence that organizational form is shaped by the same trade-offs that characterise profit-maximising firms' decision-making. This suggests that studying education markets through the lenses of the organizational economics of firms could yield important lessons about how to sharpen the effectiveness of market-oriented reforms in education. In the context of the English drive to markedly expand school competition, our insights have clear applicability: more competitive environments should increase the value of the local information held by head-teachers and their management team – as falling behind relative to competitors may be costly in terms of losses of pupil numbers. Furthermore, Acemoglu et al. (2007) argue that competition should 'discipline' local managers: faced with stiffer competition, head-teachers should have clearer incentives to focus on actions that promote standards and sustain pupil roll – thus reducing conflicts of interest with the chain board. In short, school competition should sharpen the incentives for chains to decentralise their structures.

2. Institutional background

2.1 Education stages and main features of the English education system

Compulsory education in England is divided between primary and secondary schooling, respectively covering ages 4-5 to 10-11 and ages 11-12 to 15-16. Primary and secondary education are further organised around five stages referred to as Key Stages (KS). In primary education, pupils usually enter school at the Foundation Stage (or age 4-5 or grade 0) and then move on to KS1, spanning ages 5-6 and 6-7 (grades 1 and 2). At age 7-8, pupils progress to KS2, and at age 10-11 they complete primary education (grade 6) and move on to secondary school (grade 7) where they progress through KS3 to age 13-14 (grade 9), and KS4 (age 15-16), which marks the end of compulsory education (grade 11).

At KS1, students are assessed in English and Mathematics. While the KS1 exams are externally set, they are internally marked by teachers. At KS2, students take standardised national tests in English, Mathematics and Science, which are externally assessed. At KS4, pupils sit academic (GCSEs) and/or vocational (NVQ) tests in a range of subjects, although English, Mathematics and Science are compulsory for every student. These tests are externally assessed. School average attainments at these Key Stages and measures of school average value-added are published alongside other characteristics (such as size and composition) in performance tables. These are salient in the media and routinely used by parents to inform their school choices.

Additional information on school quality is disseminated through the publication of school ratings provided by the inspectorate, Ofsted. Ofsted visits schools every three to five years and inspections result in publicly available reports rating schools from 'Outstanding' to 'Inadequate' on overall quality and on specific aspects such as teaching, management and behaviour. Although Ofsted is a non-ministerial government department, its reports are published independently of government interference. Ofsted ratings are also important for parental school choice (see Greaves and Hussain, 2022).

Admission to state primary and secondary schools is based on principles of free choice, though constrained by the fact that popular schools become over-subscribed. When this occurs, various criteria are used to prioritise students, usually favouring those who live nearby, those with special educational needs or in care of the LA, and those with siblings in the school. Certain types of schools can prioritise students according to other criteria – e.g., religion. A small proportion of secondary schools select on prior achievement or admission tests (Grammar schools). Depending on where they live, families can apply to between three and six schools. To allocate pupils to their schools, the various LAs run constrained versions of student-optimal stable mechanism – also known as Deferred Acceptance algorithm. State-funded schools enrol just below 95% of all students – with approximately 5% of the students opting for private education and a virtually nil share being home schooled.

2.2 School types and the academies programme

There are five school types in England: community, voluntary controlled (VC), foundation, voluntary aided (VA) and academy. Community and VC schools are mainly managed by the LA. This recruits teachers and staff and provides schools with most of the services they need to run their operations (e.g., back-office and accounting activities). The local governing bodies (LGBs) of these schools include members of staff, representatives of the LA and parents. VA and foundation schools enjoy more autonomy from the control of the LA, although the LA still plays a significant role on the governing body and has powers of oversight. In all cases, funding comes from the LA using money provided by central government through general taxation.

Academies enjoy far more autonomy than any of these school types, despite remaining non-fee-charging, state-funded schools. They are independent from the control of the central and local government in aspects such as staffing (e.g., recruitment and teachers' pay, staffing structures, career development, and performance management), provision of services (e.g., maintenance contracts, HR, and legal services), and setting of the curriculum (with the exclusion of core subjects – namely, English, Mathematics and Science). Strategic and day-to-day decision-making is managed by the head-teacher and its leadership team (i.e., mostly deputy heads) jointly with a board of governors with limited representation from the LA. Such board acts as a trust – and the trustees are legally (though not financially) accountable. Academies can only be non-profit organisations and funding is linked to the number of students on roll – like for all other schools. However, unlike other schools which receive funds via the LA, academies receive funding directly from central Government and acquire more administrative control – but are responsible for the maintenance of their premises and other back-office activities previously provided by the LA. Academies cannot run deficits and the Department for Education (DfE) can close academies after two years of financial shortcomings. Finally, academies have some leeway in setting their own admission criteria – although they are subject to the national guidelines stated in the Admission Code and tend to adopt the same criteria as other schools.

Academies were introduced by the Labour Government in 2002 to tackle underperformance by imposing organizational restructuring and by allowing a Government-approved sponsor – usually a charity or a business group – to 'take over' the school. The initiative was a small-scale policy, targeting secondary schools only and leveraging head-teachers' increased autonomy – backed by a sponsor-led drive for change – to improve education standards. The programme dramatically changed in May 2010 with the election of the new Conservative/Lib Dem Coalition Government. The Academies Act 2010 – passed in June 2010 – encouraged as many primary and secondary schools as possible to convert to academies and drive transformational changes to the organization of the English state school sector.[3] Since 2010 the academisation process grew dramatically – especially during the

[3] A key incentive for a school to convert is to free up funds previously kept by the LA to provide back-office activities. According to the DfE (2013) academies survey, the two most frequently cited reasons for converting were 'to gain greater freedom to use funding as seen fit' and 'to obtain more funding for front-line education'. Managerial independence and reduced bureaucratic control were also factors, with the fourth most cited reason

academic years 2010 to 2015 (which we cover in our analysis). As of June 2021, approximately 6000 (out of 16,000) primary schools and around 2500 (out of 3200) secondary schools had become academies.

2.3 Stand-alone academies and Multi-Academy Trusts (MATs)

Besides the sponsor-led/converter divide (highlighted above), another important distinction arose after May 2010. During the Labour Government, all sponsor-led academies had to join a MAT backed by a sponsor and became part of a chain. However, following the 2010 reforms, converter academies could decide to incorporate as a single-academy trusts (SATs) – with a governing body taking on full managerial responsibilities alongside the headteacher and his/her team (sponsor-led academies still had to join a MAT).

SATs – or stand-alone academies – embody the pure idea of a fully decentralised system in which each autonomous school is responsible for all its decisions and services. On the other hand, MATs are more complex structures in which school autonomy and central control coexist in ways that create peculiar institutional tensions. In principle, MATs have a single governing body – the MAT Board of Directors – that is responsible for strategic decision-making for all schools in the chains, is accountable for performance across all schools and is running all schools in the chain. Schools belonging to the same MAT therefore share the same board of governors (i.e., the Board of Directors), which can take up most of the tasks normally performed by the LGB of the individual schools.[4] Appendix Figure 1 shows a visual representation of school chains' governance structure.

The foundation Members of the Trust (i.e., the original founders and funders of the sponsor) appoint the Board of Directors (also known as Trustees). These are chosen through a formal selection process from members of the community, the teaching profession or other occupations in ways that reflects the ethos and vision of the chain.[5] Greany (2018) finds that, while all MATs are aspirational, their visions are very disparate and grounded in specific missions. Some chains are clearly performance driven and focussed on data and quantifiable Key Performance Indicators (KPIs). Others instead reflect broader objectives including fostering a comprehensive intake; embodying a specific curriculum-related philosophy (e.g., Montessori); or adhering to specific routines – such as restorative practices.

being 'to become independent of the LA'. The downside of greater freedom is that this brings increased administrative burdens and responsibilities on the school – which some schools might be unwilling to take on.

[4] The MAT model aimed at removing pressures from LGBs by avoiding the recruitment of high skill managers and governors for each single school (Grotberg and Robb, 2015).

[5] Although there is no limit to the number of years a Trustee can sit on the chain board, they can be removed by the Foundation Members, and are normally rotated to bring in new perspectives.

Although the Board of Directors in principle sets the direction for the MAT and its schools, hold headteachers accountable, and ensure financial probity, Trustees can delegate functions to headteachers and the LGBs of their schools. This is done through publicly verifiable 'schemes of delegation' – normally applying to all schools within the chain. This means that, while MATs tend to be based on a centralised model, functions and operations can be attributed to different actors along the governance chain. We return to these issues below – where we describe the information our survey contains.

Before concluding, it is worth briefly discussing MAT funding model. To support their activities, MATs 'top slice' school income – i.e., they claw back part of the school budgets (not dissimilarly from what LAs do for schools under their control). Most MATs charge a 'fixed rate', namely the same percentage of the budget applies to all schools. However, some MATs apply variables rates – usually charging stronger and more viable schools (i.e., those with a strong pupil roll and so more resources) a higher rate to support activities in smaller and more underfunded schools within the chain. Since MATs operate as charities, these funds are not used to achieve a profit (MATs are also not allowed to borrow). Instead, they are used to finance back-office activities – such as accounting and legal services – the chains provide to their schools. Some MATs have more articulated central structures that include research units to identify 'best practices' by studying data provided by their schools or surveying the academic literature – as well as outreach units that organise fund-raising events and inset days for teachers and headteachers to share ideas and receive training. Finally, members of the Board of Directors are unpaid – although CEOs of MATs are remunerated and some recent media 'scandals' (2019-2020) uncovered some CEOs' pays in excess of £250,000 per year.[6]

2.4 The rise of school chains

As discussed, the sponsor-led academy programme started off in the early 2000s as a remedial education intervention targeting a small number of secondary schools. Between the academic years 2002/2003 and 2009/2010, less than 300 school became academies – and immediately joined a small number of MATs. Consistently, the number of chains grew slowly with an average number of 8 MATs opening every year – leading to a total of less than 60 chains by the end of 2010.

[6] MATs can become insolvent – like companies. In that case, the DfE first issues a 'Note to Improve' to the Board of Directors and Foundation Members. If no financial improvements materialise, the DfE can wind up activities by issuing a 'Termination Notice'. The schools within the chain are reassigned to other MATs. To continue the parallel with companies, also note that the Foundation Members are the chain 'owners' (the term poorly applies given MATs' charitable status) and can decide to wind up the Trust (i.e., close the company).

The academisation drive brought about by the Government change in May 2010 dramatically accelerated these dynamics. Between 2010 and 2015, more than 1500 secondary schools (out of around 3200) became academies. Approximately, 12% of these (200 schools) started off as sponsor-led and immediately joined a MAT. The remaining 1300 schools instead switched via the converter route – and mostly set off as stand-alone academies. However, an increasingly large share of these joined a chain at a later stage. A similar trend characterised the primary school sector. Between 2010 and 2015 (no primary academy existed during the Labour Government), more than 15% of primaries became academies – i.e., approximately 2500 schools (out of more than 16,000). Of these, more than 30% switched via the sponsor-led route and joined a MAT right away, while the remaining chose to become converter academies. Like for secondaries, many started as SATs, but an increasing share joined a chain. The Department for Education (DfE, 2016a) 'Academies Annual Report 2014-2015' puts the overall share of academies in chains at around 70% – with nearly half of all converters (and virtually all sponsor-led) in a MAT. Recently, the DfE (2016b) estimated that at the start of the academic year 2016/2017 more than 95% of the school converting to academy were immediately joining a MAT – irrespective of their sponsor-led or converter status.

These school-level dynamics are mirrored by the rapid increase in the number of chains operating in England. In the last three months of the academic year 2009/2010 which were affected by the new Government policy (June to August), 45 MATs opened – i.e., 80% of the total number of MATs that opened under the Labour Government between 2002 and 2010. In the three subsequent academic years an average of nearly 160 chains opened per year – with nearly 240 in 2010/2011 alone (see Figure 1). While the take-off slowed down in the last three years covered by our data (up to 2016), the average number of openings was still more than 70 per year.

What accounts for the very rapid expansion of the academy chain sector? Using the words of a key stakeholder who helped us to form a better understanding of MATs, "two names explain this trend – Michael Gove and Nicky Morgan". Gove and Morgan were Secretary of State for Education between 2010-2014 and 2014-2016, respectively. Both embodied the politically motivated agenda of the centre-right Governments in power during those years whose goals were to promote competition and quasi-markets in education and remove schools from the control of the local government – to which they were ideologically opposed. As a result of this political stance, large numbers of schools were pushed to convert to academy and recommended to join a chain if administrative weaknesses meant the newly formed academy would struggle as a stand-alone autonomous school. This was true for primary schools – whose small size mostly implied the institution was unable to operate without to support from the LA – as well as secondary converters that were not 'outstanding' according to Ofsted (meaning the inspectorate had identified possible managerial shortcomings). The academisation drive was so incisive that in 2016 the Government briefly held an ambition to make all schools academies. While the plan was dropped because of opposition by teachers and a sizeable representation of parents, it has recently been reintroduced: in March 2022, the Government reinstated the ambition to see all schools become academies and join a chain by 2030.

As the number of MATs grew, their geographical representation evolved. While initially chains focussed on schools in specific LAs, the Government-driven impetus favoured geographical growth and spread. Nevertheless, in 2017 the Education Policy Institute still found that small and medium size chains with a balanced representation of sponsored and converter academies tended to mostly operate in tight geographical clusters – with schools located within an LA or within an hour-travel distance of one another. Only, the largest MATs – in particular 'System Leader Trusts' with more than 30 schools – are more geographically spread out and include schools from wider areas.

3. Data, variables and sample

3.1 Data

To carry out our investigations, we combine newly collected data and administrative records on students and schools. In this section, we discuss how construct our main variables and samples of interest.

Decentralisation practices. We obtained data on decentralisation of procurement activities from the British Educational Suppliers Association (BESA). BESA is a trade association (not-for-profit) that works with the UK education supplier sector. The association provides education suppliers as well as education providers (i.e., mostly schools) with practical advice, business leads, market reports, links to government and guidance on procurement activities and contracting issues. The data we use was collected in the September/October of 2016 by BESA and is a reliable source of information to study the organizational set-up of chains: respondents received a report – as well as tailored advice – based on the findings from research conducted by BESA on the data and had a clear interest in providing meaningful answers. The main focus of the survey was to collect information on procurement of educational and school-management activities (i.e., utilities, teaching equipment, staffing, information and communication technology, curriculum, professional development and assessment procedures).[7] However, the data was also supplemented with information on MAT size, geographical coverage, funding structures and some details on the background of the Board of Directors – which had been classified as 'business oriented', 'educationalist' or 'mixed'. We use this taxonomy applied to data we web-scraped from the UK official business records to create a proxy for the 'ethos' of the chain.

Multi-Academy Trusts governance. We web-scraped the UK Companies House website to extract data on the board composition of MATs.[8] UK Companies House is the official UK register of companies and is a managed by a Government agency. All companies – including charities – are registered with UK Companies House and file several details required by legislation. The information covers – among other items – company's address, date of incorporation (and potentially dissolution), accounting and insolvency data, and details on current and resigned officers/directors. For each officer/director, we web-scraped information on name, place of residence, birth date, nationality, occupation, appointment and resignation date. We use directors' self-reported occupation to proxy for the 'expertise' of the MAT board members. Online Appendix Table 1 presents the full job-expertise lookup table, while below we describe how we use this information to construct a measure of preference congruence between the MAT Board of Director and the school local management team.

School-level and MAT-level data. We use publicly available data on school and MAT characteristics accessible from 'Get information about schools' – an open-access repository covering all schools and educational phases in England. These school-level and MAT-level data are maintained by the DfE and include information such as location, academy type (i.e., sponsor-led or converter), date when a school converted and joined a MAT, and education phase.[9] We further complement this information with school-level data on income and expenditures from the Consistent Financial Reporting (CFR).

School governance. We gather data on school head-teachers and other members of local school management team from the School Workforce panel (SWF). The SWF is a census that tracks over time all individuals (not just teachers) working in school settings from 2010 to the current date – although we only have access to data up to 2014. The data include information on the role held at the school (e.g., head-teacher, class-teacher, cleaner, IT technician),

[7] BESA also collected full details (full names, contact number and email) of the CEO, FCO and procurement directors at the various chains to facilitate the connection between educational service suppliers and schools. Most of the chains provided this information – further attesting to the reliability of the data.
[8] The UK Companies House website can be accessed at: https://www.gov.uk/government/organisations/companies-house
[9] School-level data are regularly updated and can be accessed at: https://www.get-information-schools.service.gov.uk/

beginning and end date of the post, age, gender, wage, and degrees obtained. The SWF census is the DfE main source of data on staff pay and mobility and is used to inform Departmental policy on salaries. According to the DfE, the data is gathered on a 'collect once, use many times' principle – meaning that records for different staff are only updated when some relevant information changes (e.g., variation in pay, role, school, type of contract). This means that while the data covers the universe of schools and teachers, the SWF is not user-friendly and information has to be gathered by linking across the various waves. Each individual is also linked to information on the different levels of education they obtained (e.g., undergraduate degree, master and doctorate) and field of study (e.g., business, foreign languages, or pedagogy). We use this information to classify the background of the local management team and identify whether the school is 'aligned' with the ethos of the MAT. More details are provided below.

Student-level data. We employ administrative records from the National Pupil Database (NPD) on primary and secondary school-age students in England from 2002 to 2015 (approximately 600,000 per year). The data is collected by the DfE and covers all students in state education (not just those sitting for they Key Stage exams). The information contained in the NPD is key to the publication of official school performance tables – and is used by the DfE for school monitoring and funding. The data include test scores at the end of the primary and secondary school cycles (KS2 and KS4 scores respectively) and each student's teacher assessments at the end of grade 3 (KS1). The dataset also includes student demographics, such as gender, ethnicity, language spoken at home, eligibility for subsidized lunches and special educational needs, and each student's place of residence (we make no use of the latter detail). Finally, the NPD includes an identifier for the school attended in any given academic year, which we use to map students to schools.

3.2 Main variables

Using these data, we construct our proxies for: *i-* decentralisation of decision-making; *ii-* preference congruence between the school managerial team and the chain's Board of Directors, and *iii-* technological adoption in the context of information diffusion.

Starting with the first, we rely on the data collected by BESA in their survey and use information on the following procurement activities: utilities, teaching equipment, staffing, Information and Communication Technology (ICT), curriculum, Continuing Professional Development (CPD) and assessment procedures. We exclude information on facilities maintenance as this variable has several missing observations (approx. 20%).[10] MATs were asked whether each activity was managed centrally, managed jointly with the schools, or fully managed by the schools. Figure 2 provides a breakdown of the answers by procurement activity. The prevalence of decentralisation depends on the specific procurement activity – with more centralised decision-making in relation to utilities and ICT, and more decentralisation for assessment, curriculum and teacher equipment. To construct our decentralisation proxies, we first code centrally procured activities as zeros (0); school-devolved activities as one (1); and jointly managed activities as half (0.5). Our first decentralisation measure is then obtained by averaging across these figures (within MAT) and creating a dummy that is equal to one if such average is above half – and zero otherwise. Considering that most chains either delegate or centralise (and do not share responsibilities), this proxy measures the average tendency of a chain to decentralise activities across the seven items we consider. We also create a continuous version of this variable obtained by first taking the chain-specific average of the decentralisation decisions on the seven procurement activities listed above – and then by standardizing this variable within our sample. In some robustness checks, we also consider decentralisation of the underlying items contained in our main indicator.

To construct a proxy for preference congruence, we use data from SWF on teacher education and from UK Companies' House on MAT Directors' expertise/occupation. Considering first the SWF, we proceed as follows. First, we focus on the following roles to identify individuals who are part of the local management team: head-teacher, deputy head-teacher, executive head-teacher and assistant head.[11] Second, we classify the degrees obtained by individuals (up to three per person are reported in SWF – e.g., BSc, MSc and PhD) as belonging to the 'arts', 'education', 'foreign languages', or 'private-sector oriented' groups. Our Online Appendix Table 2 provides the mapping between degree types and groupings. To provide some examples, we classify as education the following degrees (amongst others): classical studies, English studies, linguistics, philosophy, history, and comparative literary studies; and as 'private-sector oriented' the following fields (amongst others): economics, finance, statistics, marketing, physics, and software engineering. We then define individuals' expertise as being in 'business' if they have at least one degree in a private-sector oriented group and in education if they have their degrees in education – but none in a private-sector oriented subject. This definition is meant to account for the fact that individuals working in

[10] Results obtained including facilities are similar to the main ones presented below.
[11] We do not have data on the identity of the other individuals on the LGB who assist headteachers and their deputies in their decision making.

education need to have at least one education-related degree (e.g., post-graduate teacher training qualification) – and so we take a single-degree in 'private-sector oriented' area as indicative of a business orientation. The local management team expertise is then defined as predominantly business/education if the share of individuals holding a business/education background is larger than the share of individuals holding an education/business background, and mixed if the two shares are the same. In our main definition, we treat 'arts' as providing a business-oriented background, and 'foreign languages' as providing an education-oriented one. However, we have checked the robustness of our results to treating these two groups as 'mixed' in our definition of the ethos of the local management team.

Considering instead the data from the UK Companies' House, we first classify individuals as 'clergy', 'army', 'education', 'business', 'mixed' and 'don't know'. While the first two categories are self-explanatory, the others are not – and we briefly discuss some of the most common occupations that fall into the different groups (Online Appendix Table 1 details the mapping between occupations and groupings). Starting with education, we assign to this group individuals who are headteachers, teachers, education consultants – as well as those who work as university lecturers, university tutors and deans of education. Conversely, we classify individuals as having a business background if their occupation is (amongst others) company director, management consultant, finance director – as well as solicitors, accountants, bankers and engineers. Lastly, individuals who are assigned to the mixed group mostly work in the public sector – for example, in the National Health Service, the civil service or the police – while the residual category 'don't know' gathers individuals whose background cannot be identified because they stated they were retired or had no occupation. To identify the orientation of a MAT Board of Directors, we disregard individuals who are clergy, army, don't know and mixed – and calculate the fraction of members of the Board who either have an education or a business background. A Board is then classified as education/business depending on whether a larger share of directors is of either one or the other type – and mixed if the representation of both types is balanced. This variable can then be compared with the equivalent one derived from the SWF to create a dummy that defines whether the school and the chain are 'aligned' (i.e., both are education, business or mixed) or otherwise. The average of such dummy variables across schools within the chain represents the fraction of schools within the chain that share the same 'ethos' as the MAT Board of Directors. In our analysis, we use this continuous proxy as well as a dummy that identifies MATs where the majority of schools (i.e., 50% or more) shares the same ethos as the chain Board.

Several things are worth noting before moving on. First, there is an element of arbitrariness in our classifications – so we experimented with several alternatives. For example, we took a more restrictive approach to the directors we identify as business or education – leaving more individuals in the mixed (unclassified) group. These changes did not affect our findings. Second, we measure these proxies in 2009 and in 2014. Given that so little is known about the governance of chains and schools, we believe it is informative to trace out how our preference alignment variables change over time. We discuss our findings in Section 5.1. Third, the SWF does not contain valid information on field of education for approximately 20% of the members of the local management team. This means that in some instances we cannot classify the expertise of the school. To account for this, in our regressions we control for the share of schools within the chain for which the local management's expertise could not be constructed. In some extensions, we only focus on MATs where all schools can be assigned to a grouping.

To conclude this section, we describe our proxies for technological diffusion. To construct these variables, we follow Acemoglou et al. (2007) and adapt their framework to education markets. The authors argue that decentralisation of decision-making is more likely to occur when publicly available information on 'best practices' (i.e., frontier technologies) is limited and the principal (the MAT Board of Directors) is less likely than the agent (the headteacher and his managerial team) to identify the best course of action.[12] In our context, such cases are likely to occur when: *i*- the chain operates schools that are close to the technology frontier and the Board cannot use other chains' experience to guide decision-making; *ii*- the chain operates in heterogeneous environments making it difficult to learn cutting-edge technologies from others; and *iii*- the chain is young and unable to adapt other technologies to its objectives. To construct our proxies for the first two channels, we rely on data on students' test-score value-added between KS1/grade 2 and KS2/grade 6 (for primary schools) and KS2/grade 6 to KS4/grade 11 (for secondary schools) for the academic year 2006/2007 to 2008/2009. While levels of attainments are influenced by students' characteristics (in particular, family background), test-score value-added is broadly accepted as a meaningful proxy for school productivity. Using this data, we proceed as follows. First, we average students' value-added within schools – i.e., we calculate each schools' average value-added. Second, we identify the 10^{th}, 90^{th} and 99^{th} percentiles of the LA-specific value-added distributions separately for

[12] Examples of such best practices could include: whether to deploy IT funds to support computer labs (fostering individualised learning) or classroom whiteboards (aiding regular instruction time); whether to structure teacher monitoring and lecture development through in-class observation as opposed to via pre-classroom rehearsal and teacher-to-teacher 'coaching'; or whether to centre the taught curriculum around cross-cutting theme (e.g., the concept of 'individual freedom' in literature, history, and science) or across parallel pillars.

primary and secondary schools. Third, we identify each schools' value-added distance from the 'technological frontier' as measured by the 99th percentile of the value-added distribution in the LA in which the school operates and for the relevant phase (primary or secondary).[13] Next, for each school we compute heterogeneity in technology by measuring the 2006/2007 to 2008/2009 change in the difference between the 90th and the 10th percentile of the value-added distribution in the relevant LA and education phase. Finally, we collapse this information at the chain level for all schools within the MAT by taking a simple average across schools (i.e., disregarding their size). These proxies weigh more the sectors in which the chain is over-represented (primary vs. secondary) and the LAs in which the MAT operates most of its schools. On the other hand, our measures do not incorporate the possibility that the distance to the frontier of bigger schools within the chain (or the technological heterogeneity of the market in which these schools operate) have more influence on MAT's decisions. Stated differently, we assume that chains take all their schools' technological position as similarly important when deciding whether to decentralise decision marking or not. Given that in our institutional context chains are held accountable for the viability of all schools within the organization (not just the ones with larger student roll), this seems a reasonable assumption. Finally, to proxy for a chain's age, we use the number of months elapsed between September 2016 (when the decentralisation survey was administered) and the date when the first school joined the chain. Following Acemoglu et al. (2007), we then classify MATs using indicators that identify the age quartile to which they belong.[14]

3.3 Sample construction and sample selection

The basis for our analysis of the determinants of chains' decentralisation decisions is the BESA survey described above. Of the nearly 740 'true' MATs (i.e., chains with at least two schools) that existed at the time, approximately 450 completed the survey. However, we lose observations because of missing information on school and MAT characteristics that are key to our analysis, as well as in the data we aggregate up from pupil records contained in the NPD. We therefore end up with 391 MATs including 2,049 schools. Although our sample is geographically representative of the MAT population (Appendix Figure 2), chains in our sample are larger, have fewer primaries and more sponsor-led academies and are less

[13] As discussed in the Introduction, the institutional context supports our use of the LA as the market of reference. We further disaggregate this by considering separately the primary and secondary sector. Of course, schools and MATs might be mostly comparing themselves to a subset of schools with similar traits. Although our approach abstracts from this possibility, this simplification allows us to construct proxies for the distribution of 'technologies' over a sizeable group of schools – thus yielding more reliable variables.
[14] We experiment with several variants of all these proxies to assess the robustness of our results.

geographical concentrated than in the remaining part of the population (see Appendix Table 1). Furthermore, MATs in our sample tend to have more deprived student intake and lower achievement. We do not see such sample selection as problematic: if anything, the chains we investigate are amongst the biggest and the most complex structures – more likely to have paid attention to the possible costs and benefits of the decentralization of activities.

Before moving on, we discuss the sample we use to carry out our analysis of MAT effectiveness. In this case, our level of observation is the pupil – and we make full use of the data available in the NPD. Specifically, we use information for pupils sitting for their KS2 (primary school) and KS4 (secondary school) exams in the academic years 2005/2006 to 2014/2015, matched to their prior attainments (KS1 and KS2, respectively) as well as details about the school in which they started the KS2 phase of primary or secondary education. As we discuss below, we only make use of 'legacy' students who were already enrolled in schools before these decided to join a chain. Furthermore, we drop schools with year gaps in our observation window and trim out the smallest schools (bottom 5% of the phase-specific school size distribution across all the years) – so that our school-specific estimates of chain effectiveness are meaningful (i.e., they are obtained over a reasonably large set of pupils). Appendix Table 2 shows that the 312 chains (out of 391) that we retain for this analysis are expectedly larger, have more students and tend to be older. We also find that the MATs in this sample have a lower share of primaries and converter academies – and are less geographically clustered.

4. Empirical methods

4.1 The determinants of chains' decentralisation decisions

In the first part of our paper, we investigate the determinants of chains' decisions to decentralise their decision making. Using the data described above and focussing on some key relationships identified by the organizational economics of firm, we estimate the following empirical model:

$$Dec_i = \alpha + \beta Alignment_i + \sum \delta^k \, InfoProxies_i^k + X_i \Gamma + \varepsilon_i \qquad \text{(Eq. 1)}$$

Where Dec_i captures chain i's level of decentralisation; $Alignment_i$ is a proxy for the congruence in preference between the MAT Board of Directors and the school management team; $InfoProxies_i^k$ is one of the k variables that measure the amount of information in the market and the relative technological position of the schools in the MAT (i.e., our two productivity-related variables and the MAT age dummies); X_i is a set of school, MAT and LA controls; and finally ε_i is an error term.

As discussed, our unit of observation is the chain (and not the set of schools within the chain) because we have MAT-level observations about decentralisation of procurement activities. This level of analysis is appropriate because chains decide which elements of their strategic decision-making they retain or devolve to schools via 'schemes of delegation' that are common to all schools within the chain. Given that there is no within-MAT variation, we simply treat ε_i as a potentially heteroskedastic error term and apply robust standard errors.

There are several challenges to estimating the effect of MAT attributes on decentralisation. First, we need to address issues of reverse causality – because we want to identify the association that runs from MAT characteristics to decentralisation, rather than the other way around. To deal with this problem, we measure our key proxies in 2009 – while information on decentralisation decisions was recorded in the autumn of 2016. As discussed, this date (2009) is prior to the change in Government and the introduction of the policies that led to the rapid and unexpected expansion of school chains in the English education system. Stated differently, these characteristics measured in 2009 are pre-determined to any decentralisation decisions – and to the rise of school chains – and so reverse causality issues should be minimal.[15]

The sweeping policy change also helps dealing with two further issues. One concern is that only certain schools joined MATs, or that schools manipulated their characteristics to join a chain (or remain independent). This would create some endogeneity in the characteristics of the schools we sample (i.e., those in a MAT as of 2016). As discussed, this is unlikely: the Government 'urged' (some would say 'forced') as many schools as possible to join chains as soon as possible – and irrespective of their characteristics (e.g., performance or composition). This suggests that school self-selection into/out of the MAT sector is not a very significant concern.

Nonetheless, it might still be possible that schools select to join specific chains because they have characteristics that make them more compatible with the MAT internal organizational structure. For example, high productivity (value-added) schools might join chains with more decentralising set-ups – while more centralised networks take charge of weaker schools. Such idiosyncratic match would create some endogeneity in the relationship

[15] All other controls are measured in 2016. This choice is not influential: measuring these variables in 2009 (or not including controls in our analysis) does not change our results.

between school attributes and MAT organizational decisions – biasing our estimates of β and δ^k in Equation (1). To deal with this possibility, we replicate our main result for schools located in areas in which chains held a monopolistic position –i.e., only one chain was present or a few chains held dominant shares of the market. In such instances, schools had limited choice in terms of which network to join – but were pushed to do so by Government *fiat* – so their characteristics are likely to be orthogonal to any underlying tendency of the MAT to be more/less centralised. We find that this analysis confirms our main evidence.

Last, we recognise that our key variables are 'noisy' measures of the channels we would like to identify in the spirit of the organizational economics of firms. With respect to our proxies for information diffusion and technology adoption, we follow Acemoglu et al. (2007) both in terms of the construction of our measures as well as in the extensive set of controls we add to our regressions. These include traits of the schools within the MAT (e.g., student composition), features of the chain (e.g., size, geographical concentration and balance of primary/secondary and converter/sponsor-led academies), and market characteristics (e.g., the incidence of chains and the shares of academies). With respect to our proxy for preference coherence, we go beyond previous research that has relied on measures based on trust in the regions of origin of principal and agents (see Bloom et al., 2012). We think our measure is an improvement on previous work as it captures more directly the likely alignment between chain boards and local school management – thus linking in a more intuitive way to the underlying theory.

However – and notwithstanding the steps we take to mitigate possible confounders – our study has no 'strong identification' claims to make. Instead, we make a significant contribution by providing the first exploration of the applicability of the organizational economics of firms to school chains – thereby bringing together two important strands of research (education and organizational economics) that so far have yet to interface.

4.2 The association between decentralisation and students' attainments

In the second part of the paper, we study the association between decentralisation and the impact of chains on students' achievements. To carry out our analysis, we first need to estimate the causal effect of joining a MAT on achievements. To do so, we devise a differences-in-differences (DiD) strategy that focuses on 'legacy' students who were enrolled at the school before this joined a chain. This approach has previously been used to study the impact of academisation in England (see, Eyles and Machin, 2019; Bertoni et al., 2020; and Neri and Pasini, 2020). Its key advantage is that it by-passes the potential endogeneity of pupils' school choice in relation to a school's decision to join a chain by considering only students who were at the school before such decision was taken.

In our application, we focus only on schools that are part of our core sample of academies that are in a chain by 2016 – when the procurement survey was conducted. This means we are not identifying chain effectiveness by comparing schools that join MATs to those that do not – but by comparing changes in performance over time for schools that join earlier/at a later stage. Specifically, our identification exploits the variation that comes from student attainments at the end of primary or secondary school (conditional on prior achievements) across: *(i)* pupils who start their education in schools that will join a chain within our observation window, but are not exposed to a 'chain treatment'– i.e., they complete their education before the school joins a MAT; *(ii)* pupils who start primary or secondary education in schools before they join a chain, but are exposed to 'chain treatment'; and *(iii)* pupils who start education in schools that will join a chain after the end of the time window where we have data on pupil outcomes (our attainment data stops in 2014/2015, but we sample schools that join a MAT by the autumn of 2016, i.e. the start of the academic year 2016/2017).

To deal with the econometric issues arising from the staggered nature of our treatment (see Goodman-Bacon, 2021), we use a stacked-by-event design in which pupils and schools in group *(iii)* above act as controls for schools and pupils in the other groups – stacked by the academic year in which they join a MAT. Within each stack, we define time relative to the year when the treatment starts and control for year and event-time fixed effects – to account for both event- and time-specific trends.[16] This approach is similar to the one followed by Deshpande and Li (2019). In practice, we estimate the following equation:

$$y_{islct} = \delta\, MAT_{st} + Z_{islct_{-1}}\,\Delta + \upsilon_s + \delta_c + \tau_t + \lambda_{lt} + \epsilon_{islct} \qquad \text{(Eq.2)}$$

Where y_{islct} measures the end of primary or secondary school attainments of legacy student *i* in school *s* in LA *l* belonging to cohort (stack) *c* and sitting the test at time *t*; MAT_{st} is a dummy that identifies whether school *s* has joined a chain before its legacy students sit for their exams at *t*; $Z_{islct_{-1}}$ is a vector of students' characteristics measured at the time when they start their KS2 stage or their secondary education – including lagged test scores; υ_s, δ_c, τ_t and λ_{lt} are school effects, event-time and year fixed effects and LA-specific time trends (specified either linearly or as non-parametric trends), respectively; and finally ϵ_{islct} is an error term that

[16] School fixed effects are also re-defined to be event specific. This does not affect the school identifiers of treated schools – as they appear only in one stack in our data. However, control schools (those joining MATs after 2014/2015) have different school fixed effects for the different stacks in which they appear.

we allow to be correlated across time within schools and so we cluster standard errors at the school level.[17]

Notice that in our main analysis we focus on legacy students and MAT_{st} identifies whether the school where they start their education converts before they sit for their end of primary/secondary exams. Therefore, our estimates are intention-to-treat (ITT) chain effects. In some extensions, we identify whether the school where students sit for their exams has joined a chain. This is potentially endogenous as students can change their initial assignment based on shocks that are unobservable to us – so we instrument it using the 'original' (ITT) assignment.[18] To validate our methods, we carry out several robustness checks – including an event-study showing that pre-trends in performance are flat.

We then use this DiD approach to uncover school-specific estimates of the impact of joining a MAT by estimating the following equation:

$$y_{islct} = \sum_{s=1}^{N} \delta_s \, MAT_{st} + Z_{islct_{-1}} \, \Delta + \upsilon_s + \delta_c + \lambda_{lt} + \epsilon_{islct} \qquad \text{(Eq.3)}$$

Where most terms were defined above and the expression inside the summation identifies school-specific MAT effects $\hat{\delta}_s$ obtained by interacting the MAT_{st} treatment with school dummies. Using these estimates, we also measure each chain's average effectiveness as $\bar{\hat{\delta}}_m = \sum_{s=1}^{J} \hat{\delta}_s / J$, for all J schools that belong to MAT m, and the standard deviation of school-level effectiveness ($\hat{\delta}_s$) across schools within the same MAT.[19] These measures are then used to investigate the association between decentralisation and the impact of chains on students' achievements using the following simple empirical model:

$$\hat{\delta}_{sm} = \alpha + \gamma \, Dec_m + X_s \, \Theta + Z_m \, \Omega + \zeta_{sm}$$

Where $\hat{\delta}_{sm}$ is the effect of MAT m on attainments in school s; Dec_m is a proxy for decentralisation; X_s and Z_m are school- and chain-specific controls; and ζ_{sm} is an error term. In this case, our regressions contain within-MAT across-school variation in both the dependent variable and school controls. However, our variable of interest (Dec_m) is constant within MAT

[17] We also experimented with MAT-level clustering and reached very similar conclusions.

[18] MAT exposure can vary between one and four years. In our specifications, we disregard such variation because our school-specific effectiveness analysis uses ITT estimates – as opposed to instrumental-variable (IV) ones. Using an IV approach would require estimating approximately 2,000 first-stage regressions, which would be highly impractical. We return to this point below where we present our findings.

[19] We also estimated MAT-specific effects by replacing the variables inside the summation in Equation (3) with a chain treatment dummy interacted with MAT identifiers. The difference between the two approaches is the weight given to schools and pupils within MATs when estimating effectiveness. Results were very similar.

– therefore we cluster standard error at the MAT level. When we consider MAT average effectiveness or the standard deviation of chain effects across-schools, our data is at the chain level. We therefore apply robust standard errors and drop school-level controls as these are collinear with the equivalent averaged MAT level attributes (more details are provided when we discuss our evidence below).

Before moving on, we emphasise that this analysis is 'descriptive' and should not be interpreted as yielding the causal effect of MAT decentralisation on attainment. This is for two reasons. First, our decentralisation proxies are measured in 2016, while our effectiveness measures are identified off the variation in attainment data that stop in the academic year 2014/2015. It would therefore be difficult to argue that any association runs from decentralisation to attainments – and not the other way around. However, there is a more conceptual reason why our evidence is not causal: the relationship between attainments and decentralisation we estimate is an equilibrium outcome. We have argued above – and will show below – that the organizational form taken by a given chain is likely to emerge as a result of the trade-offs a MAT needs to consider when trying to maximise the learning of students within the structure. This suggests that achievements and decentralisation are jointly determined – and so it does not matter which one we consider as dependent or independent variable. Furthermore, this also suggests that if chains choose their organization in ways that maximize students' learning, the equilibrium relationship between performance and organizational set-up should be flat. Anticipating our findings, we find that this is the case.

5. The determinants of decentralisation

5.1 Descriptive statistics

We start this section by discussing descriptive statistics for the key variables we use in our analysis of the determinants of decentralisation (Table 1).Starting from the top, we find that the mean for our main decentralisation proxy is 0.55 – although same MATs decentralised none of their decision making (proxy = 0) and other delegated all of the domains we cover (proxy = 1).[20] We also find that the average MAT age is 47 months (3.9 years) and that the oldest chain has been operating for nearly 13 years (155 months). While the proxies for the 'distance to frontier' and 'productivity heterogeneity' are harder to interpret, it is worth noting that some MATs only include schools *at* the frontier (distance = 0). Finally, we find that a Herfindahl index of geographic concentration of MATs (calculated using the shares of schools each chain

[20] Our standardized alternative has max/min values of 1.5 and -1.8 respectively, suggesting that the distribution of decentralisation activities is relatively symmetric and not overly stretched.

operates in different LAs) has a mean value of 0.8 and covers the range 0.05 to 1 – suggesting many MATs are very clustered, while a few are very dispersed.

Next, we discuss in more detail our proxy for preference congruence – as this is novel. Starting with the variables measured in 2009, we find that our continuous measure has a mean value of 0.34 – meaning that on average 34% of the schools within MATs have aligned preference. When we consider the dummy identifying chains where the majority of schools are aligned with the board's expertise, we find that nearly 39% of MATs have congruent preferences. Due to missing data on qualifications in the SWF, the average share of schools within MATs for which we were unable to reconstruct the background of the local management team is 17%. In some checks, we provide evidence that our results are unaffected if we focus on MATs with no missing data. The table also shows that the percentage of MATs with a business/economics-oriented board is approximately 50%, while the share of schools with a private-sector focussed management is approximately 36%.

As discussed, we collect information on preference alignment for 2009 and 2015. While we only use the former in our regressions, it is instructive to discuss how the proxies evolve over time. Starting with the share of business/economics-oriented chains, we find that approx. 61% of MATs in 2015 have such a focus – and that such orientation is persistent: 82% of chains that had business/economics-focussed boards in 2009 still have such background in 2015. Similarly, 60% of those that were education-focussed in 2009 retain the same ethos in 2015. These correlations remain strong even after controlling for MAT basic characteristics – such as number of schools, age and geographical spread. Interestingly, our proxy for school/MAT preference alignment instead changes substantially: the correlation between 2009 and 2015 is around 0.27 – irrespective of whether we control (or not) for some basic school and MAT characteristics. Such low correlation comes from changes in the share of school managers who have a private-sector oriented background: the correlation between the shares of private-sector focussed individuals on the local management team in 2009 and 2015 is approximately 0.50 – with most of the variation coming from changes in the identity of the head-teacher. Importantly, such changes are not correlated to whether the MAT itself has a private sector orientation – with associations of around 0.03-0.07 depending on whether we control for MAT characteristics. This suggests that business- and education-oriented chains drive changes in school local management in similar ways. Nonetheless, such variation over time – and its potential endogeneity – strengthen our claims that it is 'safer' to focus on variables measured in 2009.[21]

Before concluding, we provide some descriptive evidence on how a business orientation is correlated to school resources. Our evidence is presented in Appendix Table 3. The first seven columns of the table focus on items of expenditure while the last two focus on funding. Throughout, we control for a set of characteristics that are institutional drivers of resources – such as number of pupils, number of students with special-need or eligible for free meals, and school phase. Starting from the top panel, we find no association between overall school expenditure and the share of the local management team that has a business-oriented background. This is not surprising as overall spending is anchored to the total amount of funding received from the Government which is not expected to change with the characteristics of the local management team (Column 8). However, we find a positive and significant association between the share of business-oriented local manager and the resources spent on learning (Column 5) and back-office activities (Column 7), most likely funded by using the school facilities (and other services it provides) to generate extra resources (Column 9).[22] The bottom panel instead on MATs by summing up school funds and revenues at the chain level. As discussed, MATs are mostly funded by top-slicing school resources – and no consistent data exist on how MATs use such funds. As a result, this panel is not particularly informative. Nonetheless, we see that chains with a business-oriented board include schools that on average spend more on back-office activities and raise more funds by 'commercialising' their facilities (these associations are not significant but they are two of the most sizeable ones). They also spend more on development and training – but not learning resources. All in all, this evidence suggests that a business-orientation – in particular at the school level – is associated with different uses of resources and sources of funding.

5.2 Main regression evidence

We present our main findings in Table 2 – where we tabulate results using a dummy identifying decentralised chains as our dependent variable (described above). Column (1) only includes our four key proxies.[23] As predicted by the organizational economics of firms, we find that chains that cover schools that are on average further away from the technological frontier are

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[21] The bottom part of the table presents some descriptives on the controls included in our regressions. On average, MATs include 60% converters and 65% primaries; they group nearly six schools; and have more than 2,400 pupils on roll. Around 17% of these students are eligible for free school meals and 78% are White.

[22] Hard evidence on what this means in practice is not available. Anecdotally, schools often rent out their sports hall to local clubs; their dining halls for cooking courses; or their drama rooms for acting classes.

[23] All columns include a control for the incidence of missing information on school/chain preference alignment.

less likely to decentralise decision making. We also find that age is strongly and non-linearly linked to a chain's decision to decentralise decision-making. This is similar to the findings in Acemoglu et al. (2007). Conversely, we find that productivity heterogeneity measured as the 2007-to-2009 change in the difference between the 90th and 10th percentile of the (LA- and phase-specific) value-added distribution is not significantly associated to decentralisation. Lastly, we find that preference congruence – proxied by a dummy identifying chains where the majority of school has an ethos aligned with the MAT board expertise –
is a significant predictor of decentralisation.

Next, in Column (2), we retain the same specification – except for our proxy for distance to the technological frontier, which we now split into its two components: *i*- the average value-added of the schools in the chain; and *ii*- the average frontier of the markets (LAs) in which the chain operates. According to theoretical framework presented by Acemoglu et al. (2007), the two proxies should enter the decentralisation regressions with opposite signs – but coefficients that are similar in magnitudes. Our results point in this direction, although they are not highly conclusive. The average value-added of schools in the chain carries a positive coefficient (0.17), which is however not significant; conversely the market frontier is estimated to have a sizeable (-0.36) and significant negative effect. A test for the equality of the two coefficients (in absolute value) accepts the null with a p-value of 0.2357 – although this is in part due to the large standard errors on the value-added coefficient. Considering the small sample size we are working with, we take this evidence as suggesting that the mechanisms formalised in the Acemoglu et al. (2007) broadly apply to school chains.

In Columns (3) to (5), we progressively add controls for the characteristics of the chains (e.g., number of schools and number of pupils; geographical concentration) and their schools (e.g., students' demographics); information on teachers and the school leadership team (e.g., total number of teachers and size of the management team); and market-level controls (e.g., share of academies in the LAs where the chain operates).[24] This does not meaningfully alter the conclusions we reached in Column (1) – although we now find a borderline-significant association between decentralisation and the dummy that identifies chains in the 25th-to-50th percentile of the age distribution. Finally, Column (6) we split once again the distance to frontier proxy into its two underlying components – and find patterns that are comparable to those presented in Column (2).

[24] Full details are provided in the note to the table.

Importantly, across all columns we control for a dummy identifying MATs with a business/economics focussed board. We find no evidence that business-oriented chains decentralise more than mixed or education chains. This is an important finding as it suggests that it is *not* the specific orientation of the MAT board that determines decentralisation – rather it is its alignment with the background of the local management team.

To further strengthen the credibility of our novel proxy for alignment, we perform the following falsification test. To begin with, we construct a placebo proxy for preference congruence obtained by randomly assigning headteachers/other members of the local management team and board members to a business or education background.[25] We repeat this step five hundred times and each time we estimate the model of Column (5), Table 2 using our 'fake' alignment proxy. We then retrieve all these estimates and compare them to the 'true' estimated impact of preference alignment (0.1231). Our evidence is presented graphically in Figure 3. This shows that such variables on average do not enter our regressions significantly – the mean estimated placebo-effect is -0.008 while the median is -0.011. This suggests our congruence variables picks up some meaningful information – and not just noise.

How sizeable are these effects? Using the estimates of Column (5), we find that a one standard deviation increase in the distance to frontier decreases the chances of decentralisation by nearly 12%. Furthermore, chains in the bottom 25% of the age distribution are 66% more likely to decentralise than the 25% oldest chains – while those in the next quartile are only 40% more likely to decentralise (this effect is borderline significant). Finally, we find that chains where the majority of schools are aligned with the MAT board expertise are approximately 22% more likely to decentralise. In short, our results not only lend some support to the applicability of the organizational economics of firms to school chain, but also capture meaningful economic effects.

5.3 Dealing with endogeneity concerns

As discussed above, one concern with a casual interpretation of the results presented above is the possibility that schools select to a join specific chain because they have attributes that make them more compatible with the MAT's structure. Such school-chain idiosyncratic match would create some endogeneity in the relationship between school attributes and MAT organizational decisions – biasing the estimates of our variables of interest. To deal with this possibility, we replicate our main result for schools in areas in which MATs held a dominant position. In such

[25] We perform this random assignment in a way that mirrors the proportions of headteachers, other local managers and board members identified in the various categories as in the original data (including the missings).

cases, schools had limited choice in terms of which chain to join –and their characteristics are more likely to be unrelated to any underlying tendency of the MAT to be more/less centralised. We present our evidence in Table 3.

Column (1) reports our favourite specification – already presented in Column (5) of Table 2. In Columns (2), we add a control for the concentration of the market in which the chain operates at the time when its schools joined the organization. To construct this variable we start by calculating, for each LA and each year in our data, a Herfindhal index based on the shares of schools belonging to a specific MAT. Each school joining a MAT is then given the LA- and year-specific value of such Herfindhal index. Stated differently, each school entering a chain is given a measure of how competitive the market was in terms of chain penetration at the time when the school joined. Adding such control (averaged across all schools in the MAT) does not affect our findings.

In Columns (3), we only consider MATs that operated in monopolistic conditions when their schools joined. Specifically, we use the Herfindhal index to identify chains with average concentration values above the median of the concentration distribution – and only retain these for our analysis (i.e., we drop half of the MATs with concentration below the median). Our key associations retain their sign, size and significance level – with the exception of preference alignment which is now smaller and not significant at conventional level, although the point estimate is still two-thirds of our baseline estimate of Column (1). Considering this approach leaves us with less than two-hundred observations, this is reassuring.

In Column (4) we take a variant of this approach and drop schools within MATs (instead of MATs) if the LA concentration measure in the year in which they joined the chain was below the median of the concentration distribution at that time. This restriction in turn drops 144 MATs with only schools that joined in competitive environments – leaving us with 247 chains (and associated characteristics measured only for schools that joined under monopolistic conditions). This approach confirms our main findings – with the proxy for preference alignment now slightly larger than in our baseline specification and significant at better than the 10% level. All in all, these checks corroborate a causal interpretation of the results presented in Table 2.

5.4 Further robustness checks

Table 4 presents a number of additional checks on our favourite specification (i.e., the one in Column 5 of Table 2). Column (2) and (3) test the robustness of our definition of distance of the technological frontier. To begin with, in Column (2) we deal with the fact that value-added measures have been shown to fluctuate from one year to the next – and the choice of a specific year (in our case 2009) could affect the coefficients estimated for distance to frontier. To address this issue, we reconstruct our variable considering schools' average value-added between 2007 and 2009. This approach does not affect our conclusions. Next, in Column (3) we identify the technological frontier using the 95th percentile of the (2009) value-added distribution – instead of the 99th percentile. Although our findings point in the same direction – with a similar point estimate – their significance is weakened. This suggests that decentralisation is more strongly associated with the relative position of the chain's technology with respect to the very top of the productivity distribution. We also constructed a distance-to-frontier proxy based on levels of achievements (as opposed to value-added). We found this enters our specification with a small and insignificant coefficient (-0.048; s.e. 0.176) – suggesting that in our context value-added is a better proxy for school productivity.

Next, in Column (4) and (5) we test the robustness of our definition of technological heterogeneity. These checks are important as our main results find no association between productivity heterogeneity and decentralisation – which runs counter previous evidence in the firm-related literature. In Columns (4), we measure heterogeneity by using the difference between the 90th and the 10th percentiles of the (LA- and phase-specific) value-added distribution – instead of the 2006-2008 change in the difference between these percentiles. This does not affect our findings. In Column (5), we define heterogeneity by using the difference between 90th and the 10th percentile of the distribution of the 2006 to 2008 value-added changes (instead of the changes in the percentiles in the value-added distribution). This alternative does not affect our findings. In some additional checks (not tabulated for space reasons), we constructed our proxies for the heterogeneity of technology using levels of achievement – instead of value-added. We still found no evidence of a significant association.

Columns (6) to (8) further probe the robustness of our proxy for preference alignment. In Columns (6), we drop chains where we could not reconstruct the background of the leadership team for half of the schools – and so we could not construct a measure of preference alignment. This approach leaves us with approximately 85% of the original sample (328 chains) – but does not affect our conclusions. In Column (7), we take a more stringent approach and only retain MATs where we could construct our proxy for preference alignment for all schools – cutting our sample down to 204 chains (or just above 50% of the full sample). Once again, this does not affect our conclusions: we still find a positive and significant association between preference congruence and decentralisation – significant at the 10% level (despite the small sample size). Finally, in Column (8) we revert to our full sample but use a continuous version of the proxy for preference alignment that considers the shares of schools whose leadership team's background was aligned with the ethos of the MAT board. This approach yields a significant and sizeable association between preference congruence and decentralisation: a one standard deviation increase in our proxy increases the likelihood of decentralisation by 8.5%.

Lastly, in Column (9) we use our main specification but replace our dichotomous dependent variable with a continuous and standardized version of our decentralisation proxy. This confirms our key insights both in terms of significance and economic magnitudes. A one standard deviation increase in the distance to the frontier increases decentralisation by 14% of a one standard deviation; MATs with a majority of schools aligned with the board ethos are 26% of a standard-deviation more decentralised; and chains in the bottom two quartiles of the age distribution are nearly 80% and 46% of a standard deviation more likely to devolve decision making. On the other hand, we still find no association between decentralisation and productivity heterogeneity.

We further tested the robustness of our findings along other directions. First, we replaced the MAT-age dummies with either a variable counting chains' age in months or this variable and its square – to investigate non-linearities in the impact of age. This approach did not alter our main conclusions. Second, we used information on funding structures of the MATs to control for whether the chains explicitly apply 'budget slicing'; and whether they charge fixed/variable rates. These additional controls do not affect our findings. Third, we investigated whether our findings are robust to alternative ways of measuring decentralisation – for example, by recoding activities that are shared as zeros (instead of 0.5) or by including 'facilities' amongst the items used to determine decentralisation. These changes did not affect our results. Next, we coded foreign languages and arts as providing members of the school leadership team with a mixed (instead of education and business/economics as in our main analysis) and recomputed our preference alignment proxies. This also did not change our evidence. Lastly, we investigated the relationship between our key proxies and decentralisation item-by-item. Our findings are tabulated in Appendix Table 4. We find that distance-to-frontier is more strongly and significantly associated with decentralisation of assessment, professional development, ICT, staffing and utilities procurement – and less so for curriculum and teaching equipment. The non-linear impact of age is mostly visible for ICT, curriculum, staffing matters and utilities. Finally, the association between decentralisation and preference congruence is significant for curriculum, teaching equipment, staffing and utilities related items. Nevertheless – irrespective of the actual size and significance – our proxies are correctly signed and point in the right direction across all the different domains. Although there is some heterogeneity across the columns presented in the table, we prefer not to draw firm conclusions as to which items are more affected by our proxy as our data is possibly 'too thin'.

6. Decentralisation and chains' effectiveness

6.1. Estimates of the effect of chains on school attainments

In this section, we study the link between chain's decentralisation and pupils' achievements. Before we do that, we briefly discuss our estimates of the effect of joining a MAT on students' test scores. Our approach exploits a stacked-by-event D-i-D design strategy applied to legacy students who were already at the school before it joined a chain. More details were provided in Section 4.2.

Results that pool across all schools and MATs in the sample (estimated using Equation 2) are presented in Appendix Table 5. Across all columns, the dependent variable has been standardized so that results can be interpreted as percentage changes of a one standard deviation in the attainment distribution. Standard are errors clustered at the school level (we experimented with MAT-level clustering and found no differences in terms of statistical significance). Columns (1) and (2) measure students' attainments using test score value added – i.e., the difference between KS2 and KS1 test scores for primary school students and the difference between KS4 and KS2 test scores for secondary school pupils. Column (1) does not include controls for pupil background, while Column (2) further adds students' gender, ethnicity and free school meal eligibility. We find that students' value-added increases by approximately 6% of a standard deviation after a school has joined a chain. In Column (3), we replace our dependent value-added variable with a measure of students' final attainments (i.e., KS2 and KS4 for primary and secondary school students, respectively) while controlling for baseline attainments (i.e., KS1 and KS2 for primary and secondary school pupils). We still find an impact of approximately 5.5% of a standard deviation – significant at more than the 1% level. Columns (4) and (5) test the robustness of this finding by adding LA-specific linear (parametric) time trends and LA-by-year (non-parametric) effects. This does not significantly affect our results.

Before moving on, we discuss a number of checks we carried out. To begin with, we examined whether the parallel-trend assumption required by our DiD approach hold in our sample. Our evidence in presented graphically in Appendix Figure 3 where we report an event study showing the impact of joining a chain on students' test scores using the specification of Column (3) of Appendix Table 5. Year 0 represent the year in which legacy students were already enrolled at the school – and the school made a potential transition into a chain after the start of the academic year. Years 1 to 4 instead are academic years in which the school has already joined a MAT and so could impact students' grades throughout the academy years. The timeline is normalised on Year -1 – the year before students are legacy-assigned to schools – and all years before Year -7 have been grouped together. Our evidence shows that there were no trends in attainments before schools joined their MATs. However, we see a small performance up-tick in Year 0, which could be due to the fact that: some schools join a MAT later in the academic year during which students have been legacy-assigned (based on their school at the start of the academic year); and some schools first start as stand-alone academies and then join MATs. To check whether the latter issue affects our findings, in Column (6) we study the impact of school academy conversion – instead of the impact of joining a chain – on pupils' attainments using the same specification as in Column (5). As discussed, up to 2010 all academies had immediately to join a chain. However, after the 2010 reforms, academies could first start as stand-alone autonomous schools and join a chain at a later stage (or not join at all). In practice, this does not seem to be a significant issue in our data: Appendix Table 6 shows that the number of schools that join a chain 'off-diagonal'– i.e., not at the time of conversion – is small. Nevertheless, we directly check this issue by estimating a specification where we include both a dummy for conversion and a dummy for joining a chain – which can be separately identified for off-diagonal schools. We found that the impact of joining a chain dominates (at 0.058, significant at better than the 5% level) – while the effect of conversion alone is small and insignificant.[26] Lastly, in Column (7) we present our IV strategy where we predict attendance at a school in a MAT at the time of the KS2/KS4 exams using legacy assignment to a chain/non-chain school. School mobility in our sample is relatively limited – giving us a strong-first stage with a coefficient of approximately 0.84 and significant at better than the 1% level. Consistently, our IV estimate is not far from our ITT effect – at just below 6% – and highly significant.[27]

6.2. School- and MAT-specific effectiveness

[26] This is consistent with Neri and Pasini (2020) who show that most of the benefits of primary school conversion to academy are concentrated amongst those that join a chain.

[27] We also investigated whether our results differ for primary/secondary schools and for the sponsor-led/converter academies (results are not tabulated). We find that the impact of joining a MAT is almost three times larger for primary schools (8.9% of a standard deviation) than for secondary schools (3.5% of a standard deviation) – but significant for both. We also find that the effect of entering a chain is much larger for sponsor-led academies – at 12.9% of a standard deviation and highly significant. On the other hand, we find no effects for converter academies. This is consistent with previous work (Bertoni et al., 2020).

In this section, we briefly discuss our school- and MAT-specific effectiveness estimates. These come from specifications identical to those of Column (3) of Appendix Table 5, where we allow each school to have its own specific estimated effect (see Equation 3, Section 4.2). Our findings are presented graphically in Appendix Figure 4. The top-left panel focuses on school-specific estimates; the top-right panel presents the associated t-statistics to gauge their significance; the bottom-left panel presents MAT-averaged effects; and finally, the bottom-right panel depicts the standard deviation of school-specific effects within MATs.

The top-left plot shows that there is considerable variation in the school-specific estimates. The median/mean effects are 0.069/0.077 respectively, while the $25^{th}/75^{th}$ percentiles of the school-specific estimate distribution are -0.067/0.218, respectively. The top-right panel presents the distribution of the t-statistics for these estimates – showing that many are highly significant. The median/mean t-stats are 13.77/16.27, with top and bottom 25^{th} percentiles of the distribution at 43.40 and -13.35, respectively. The bottom-left panel presents MAT-averaged estimates. Unsurprisingly, these show less variation than the school-specific estimates – but still cover quite a wide range of effects. We find a median/mean effects of 0.075/0.069, respectively – with top/bottom quartile effects of 0.159 and -0.02. Finally, in the bottom panel we present evidence on the within-chain, across-school variation in effectiveness. This reveals a significant amount of heterogeneity. While the least dispersed MATs in the bottom 10% and 25% of the distribution have 0.048 and 0.095 standard deviations respectively, those in the top 25% and 10% have standard deviations of school-specific effects of 0.254 and 0.335. The median/mean of the standard-deviation distribution are 0.181/0.187, respectively.

6.3. The association between decentralisation and effectiveness

In this section, we relate the variation in MAT effectiveness presented in Appendix Figure 4 to our measures of chain decentralisation.[28] We start presenting our findings graphically in Figure 4, which depicts scatterplots of the association between decentralisation and: *i*- school-specific estimates (Panel A); *ii*- MAT-averaged estimates (Panel B); and *iii*- within-MAT, standard-deviation of school-specific effectiveness (Panel C). We use the continuous, standardised version of our proxy for decentralisation used in Table 4, Column 9 – as scatter plots of

[28] In this analysis, we use reduced-form rather IV estimates as using the latter would entail estimating as many first stages as schools in our sample (about 2,000). We note, however, that the fraction of 'stayers' within each school is not associated to the extent of chain decentralization. This suggests that the associations we present next are not biased by potentially different school-specific first-stages (i.e., by differential pupil mobility after original legacy assignment) in more/less decentralised chains. Results are available from the authors upon request.

effectiveness against our binary proxy are not very informative. We consider our dichotomous indicator later when we discuss our regression findings.

Across all three panels, we find little evidence of any strong association – positive or negative – between chains' organizational structure and effectiveness. The top two panels depict a slightly negative relationship between decentralisation and effectiveness – although this is not very marked – while the bottom panel presents a moderately positive association between decentralisation and effectiveness dispersion – although again this is also virtually flat.

We assess these *prima-facie* findings more thoroughly in Table 5 where we present regressions that measure the association between effectiveness and decentralisation. The first three columns use the same continuous standardized proxy for decentralisation used in Figure 4; the next three columns instead focus on the binary decentralisation variable we used in the analysis of Table 2. The top panel focuses on school-specific effectiveness estimates and runs regressions at this level of aggregation with standard errors clustered at the chain level. The central and bottom panels instead focus on MAT-average effectiveness and the standard-deviation of effectiveness within-MATs. Regressions are therefore at the MAT-level and standard errors are robust. As a result, Columns (1) and (4) in Panels B and C are empty as we cannot estimate specifications that only include school characteristics when the unit of observation is the chain – these characteristics are instead included as MAT averages in the subsequent columns.

The top panel confirms the insights gained from Figure 4: the relationship between decentralisation and effectiveness is essentially flat. The coefficient in Column (1) is negative and significant, but the association becomes smaller and less significant as we add controls and vanishes completely when we consider our dichotomous proxy (Columns 4 to 6). Panel B provides a similar intuition. The estimates of Columns (2) and (3) are small and borderline significant: a one-standard deviation increase in decentralisation corresponds to approximately 1.4% of a standard deviation change in the MAT-average effectiveness distribution. Similarly, we find no significant association when using the binary measure (Columns 5 and 6). Lastly, the bottom panel shows that there is no significant association between the continuous proxy for decentralisation and dispersion of effectiveness within-MATs, across schools – and a positive but small relationship when considering the dichotomous organizational variable.

As discussed above, we view the evidence from this analysis as mostly descriptive: the relationship between attainments and decentralisation is an equilibrium outcome – and the organizational form taken by MATs emerges from the trade-offs the chains consider to maximise pupils' learning. This intuition also helps explaining the lack of any strong association between decentralisation and effectiveness: the equilibrium relationship between performance and organizational set-up should be flat – because chains choose their structures optimally to maximize learning on average within the group.

To conclude our analysis, we investigate whether the association between decentralization and effectiveness differs for schools with different attributes within the chain. Our evidence is presented in Figure 5. The different plots reports point estimates (solid dot) with 95% and 90% confidence intervals (bold and light lines, respectively) obtained from different regressions of school-level effectiveness on a continuous measure of decentralisation. The left panel considers all schools within the MAT, while the right panel only considers schools that joined a MAT under monopolistic conditions (see discussions in Section 5.3 regarding Table 3, Column 4). All specifications include school, MAT and market-level controls, and the top row reproduces our baseline estimates. Our evidence suggests that the association between decentralisation and school effectiveness is slightly more negative for primary schools – although this difference in not particularly marked and is reversed when only considering schools in monopolistic chains. We also find that the association between decentralisation and effectiveness is more negative for sponsored schools and for schools with an incidence of free school meal eligible (less affluent) pupils above the within-MAT median. This is the case among all schools as well as those that joined the MAT under monopolistic conditions. We find similar but less clear patterns when focussing on students' ethnic background. Finally, we find some evidence of a more negative association for schools that are below the within-MAT median of the value-added distribution – suggesting that decentralisation is associated with lower performance for the weakest schools within the chain.

Once again, we emphasise that these estimates are descriptive – as they capture equilibrium relationships – and we interpret them using the following logic: through schemes of delegation that are uniform across schools in the chain, MATs choose their organizational structures in ways that maximise overall (average) learning within the organization – and in this sense the organizational structure of a chain is orthogonal to the characteristics of any one specific school. While beneficial for the chain overall, this can pose within-MAT distributional issues – by creating schools that 'win' and 'lose out' from more decentralised decision making.[29]

[29] This logic rests on the assumption that schools do not join chains based on idiosyncratic match effects that make some schools more suitable for specific chain structures. The right-side panel of the figure addresses this issue by focussing on schools that joined a chain in a monopolistic market with limited choice.

7. Conclusions

In this paper, we have studied the internal organization of school chains using detailed survey data on the decentralisation decisions of procurement activities for approximately four-hundred English MATs coupled with census data on schools, teachers and pupils over a number of years.

To guide our analysis, we have 'worn the lenses' of the organizational economics of firms and adapted the insights provided by literature on incomplete contracts, information diffusion and technological adoption. The key intuitions of these areas of investigation suggest that decision-making should be decentralised when local actors have an information advantage (or an incentive to take initiative) compared to the central management – and so are more likely to make choices that maximise the benefits for the organization. However, decentralisation comes at the cost of loss of control – and is more likely to occur when the preferences of the principal and those of the agents are aligned so that their (maximisation) objectives tend to coincide.

Our empirical evidence supports most of the predictions offered by these frameworks. This suggests that the internal organization of school chains is shaped by trade-offs similar to those faced by private profit-maximising companies. We also investigated the link between the internal structures of chains and students' performance – and found little association between decentralization and performance. While at first surprising, this is consistent with the intuition that chains choose their organization to maximize output – i.e., students' learning – and so the equilibrium relationship between achievement and organizational set-up should be flat.

We believe our findings are novel and make a significant academic contribution by bridging the gap between two important fields of economics – i.e., the economics of education and the organizational economics of firms – which have so far remained disjoint. This disconnect is somewhat surprising given the policy focus on market-oriented reforms in education that emphasise the role of incentives – for schools and for their students – in the context of school autonomy and school choice.

Our work has shifted the attention from individual schools to school chains – and has provided evidence that these tend to react to the same forces that determine the organizational set-up of (profit-maximising) firms. Such change in focus is important given the growing role played by school chains in several institutional contexts – such as the US, the UK, Sweden and Chile – that pioneered autonomy in education, but are seeing more and more of their schools being bound together within organizations with varying degrees of centralisation of decision-making.

At present, little is known about the determinants and effects of differences in the organizational set-up of school chains. Our paper has aimed to fill this gap and has offered a new perspective on these issues – suggesting that the insights of the organizational economics of firms could yield important lessons on how to sharpen the effectiveness of market-oriented reforms in education.

Needless to say, our work is just a first attempt at exploring the connections between these two branches of economics – and we have taken a very static perspective. Future work will investigate how the organizational economics of firms can be used to study the dynamics of chains and their schools. To begin with, the Covid19 crisis has offered us with a unique 'natural experiment' to study how more or less centralised structures perform during times of crisis when the delivery of education is significantly disrupted. Aghion et al. (2017) provides us with a useful framework to think about how the need to leverage local information advantages vs. the need to make 'tough decisions' could favour decentralised or more integrated firms (chains, in our case) during turbulent periods. Furthermore, recent initiatives by the UK government have tried to foster 'school swaps' between chains and take overs of weak networks by stronger chains. Studying such dynamics through the lenses of the merger-and-acquisition literature in the context of incomplete contracts and information diffusion seems like a promising avenue for future research.

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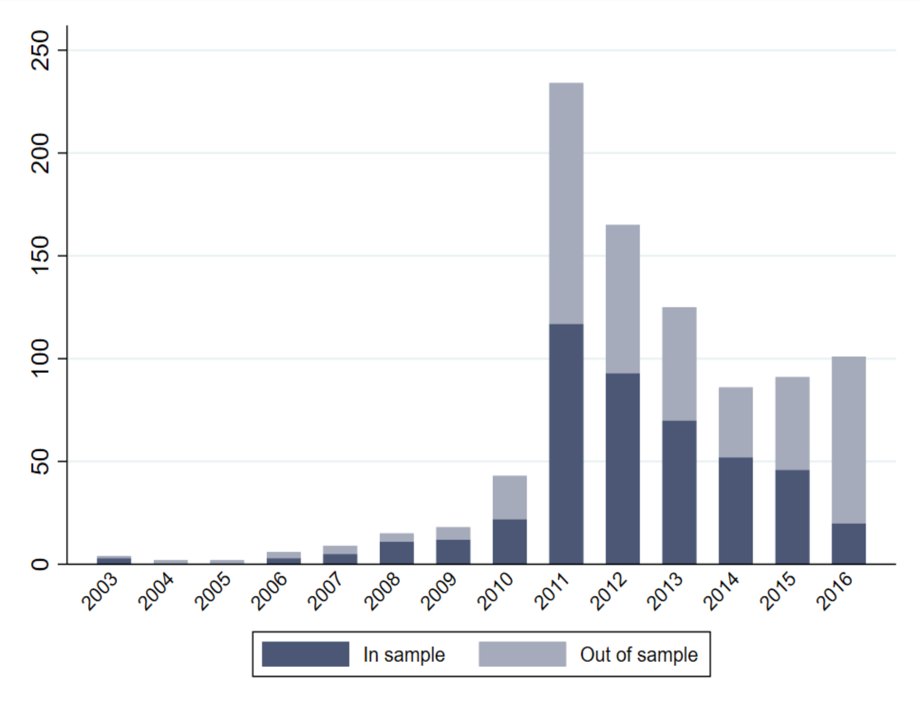
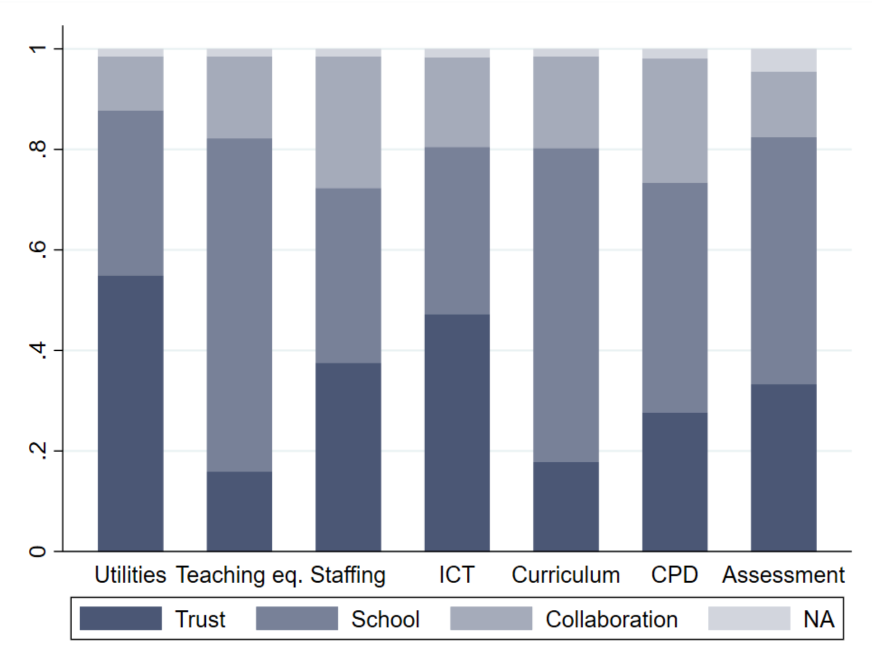
Figure 1: Number of MATs opening by year



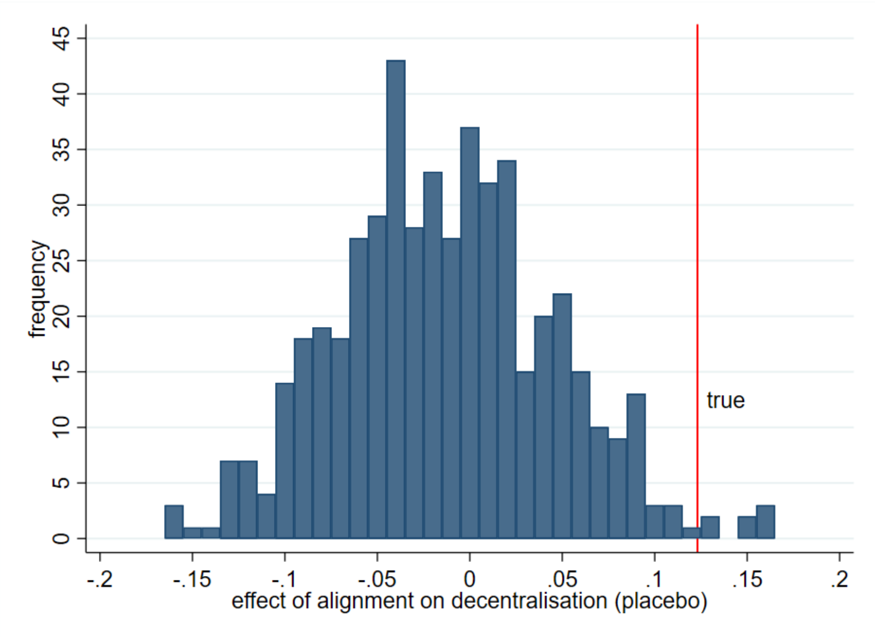
Notes: numbers are based on the academic year in which the first school of the MAT joins the organization. No MATs existed before the academic year 2002/2003.

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



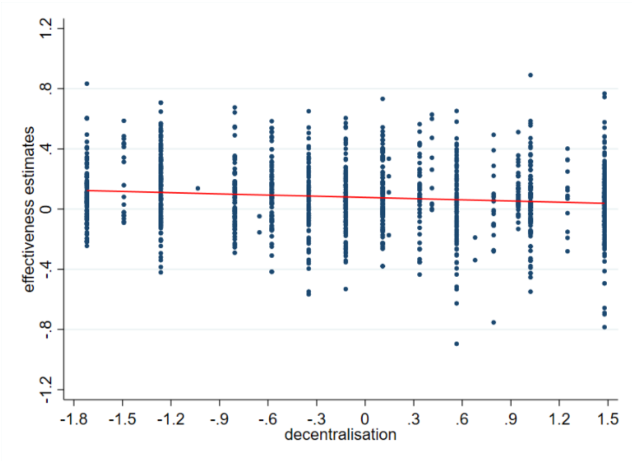
Notes: data available from the BESA survey of MATs. The exact number of observations varies depending on the specific item. Information on procurement and decentralisation of facilities maintenance is not tabulated (or used in the main analysis) due to a large number of missing observations.

Figure 3: Distribution of Placebo Estimates for School – MAT Board Alignment

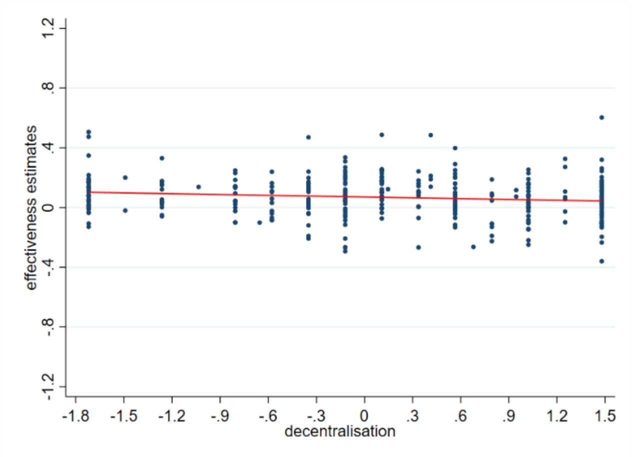


Notes: the figure reports the distribution of the estimates of the placebo school – MAT board alignment obtained by replicating 500 times the procedure outlined in Section 5.2. The estimates were obtained using the specification in Column (5) of Table 2. The mean and median values of the distribution are -0.008 and -0.011, respectively. The red vertical bar highlights the 'true' estimate (0.1231; see Column (5), Table 2).

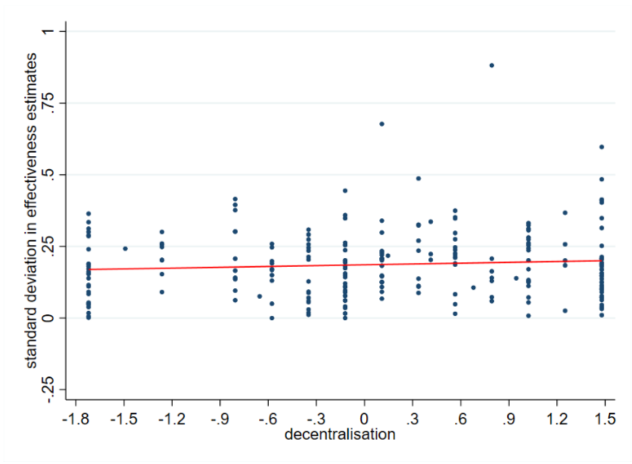
Figure 4: Effectiveness and decentralisation



Panel A. Schools



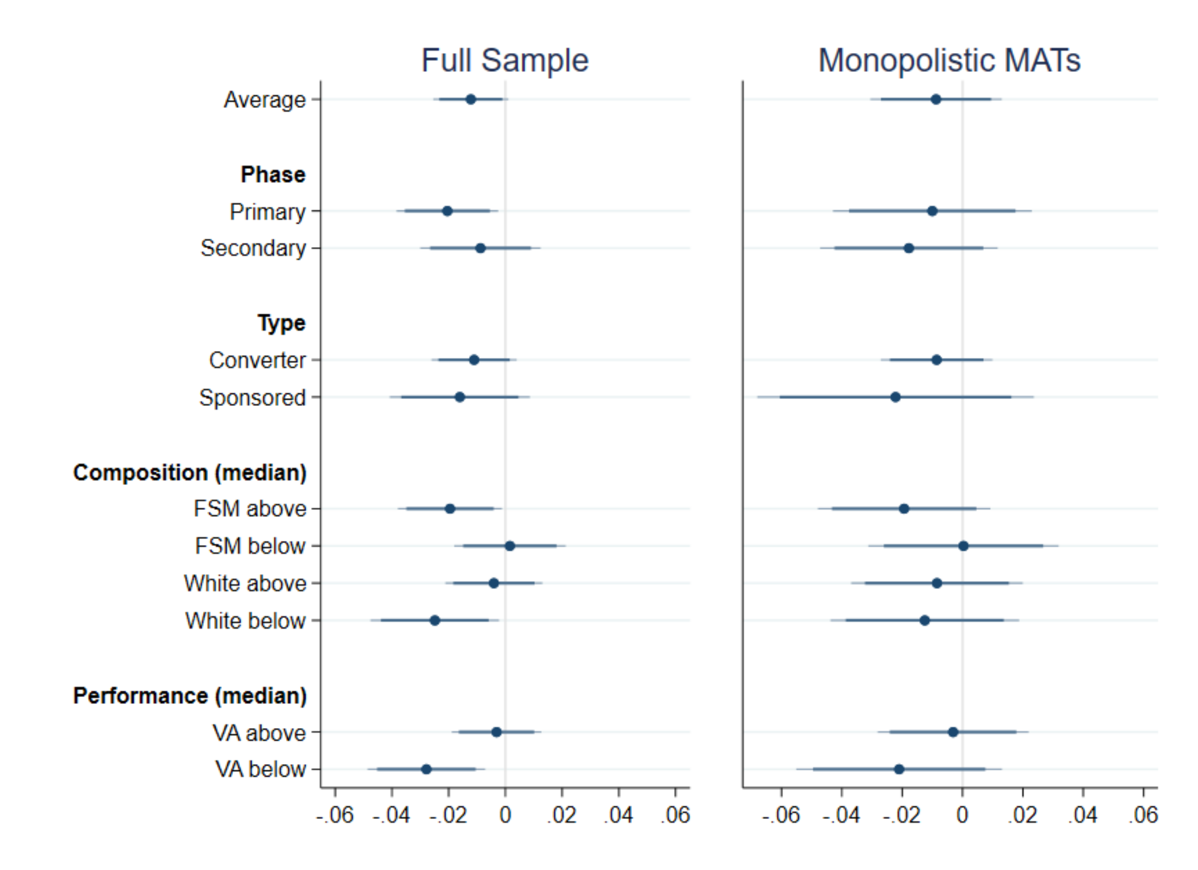
Panel B. MATs



Panel C. Standard deviation of effectiveness

Notes: the figure shows scatterplots of school- and MAT-specific effectiveness estimates (Panel A and B respectively) and within-MAT dispersion in effectiveness estimates (Panel C) on a (standardised) continuous measure of decentralisation that individuates the share of activities, excluding 'facilities', that are delegated from the MAT Board to the local school Governing Boards (see main text for details). The superimposed red lines are linear fits.

Figure 5: Decentralisation and effectiveness - Heterogeneity by school characteristics



Notes: the different plots reports point estimates (solid dot) with 95% and 90% confidence intervals (bold and light lines, respectively) obtained from different regressions of school-level effectiveness on a continuous measure of decentralisation. The right-side panel considers all schools within the MAT, while the left-side panel only considers schools that joined a MAT under monopolistic conditions (see discussions in Section 5.3). Median for the variables computed within-MAT and using all schools. This approach is meant to capture the relative position of the school within the chain. All specifications include school, MAT controls and market-level controls. The top rows reproduce our baseline (average) estimates (reported in Table 5, Columns 3 and 6). The following rows present results for different school types as defined in the main text.

Table 1. Descriptive Statistics

	Mean (1)	SD (2)	Min (3)	Max (4)
MAT characteristics				
Decentralisation (dummy)	0.5524	0.4979	0	1
Decentralisation (standardized)	0.0773	1.0256	-1.7793	1.4619
Age (months)	47.35	23.86	1	155.00
Distance to frontier - Value Added (2009)	0.6967	0.2575	0	1.5036
MATs Value Added (2009)	-0.0512	0.1867	-0.6313	0.6607
Heterogeneity - Value Added (change 2007-2009)	0.0139	0.1124	-0.3046	0.7697
School and MAT board alignment (2009)	0.3397	0.3543	0	1
Majority of schools aligned with MAT board (2009)	0.3887	0.4881	0	1
Percentage of economics/business trust boards (2009)	0.5038	0.5006	0	1
Percentage of economics/business trust boards (2015)	0.6138	0.4875	0	1
Percentage managers with business/private sector degree (2009)	0.3637	0.2176	0	1
Percentage managers with business/private sector degree (2015)	0.3750	0.2405	0	1
Board alignment information imputed (2009)	0.1692	0.2111	0	0.80
Herfindahl index of geographical dispersion (2015)	0.8264	0.2730	0.0537	1
Percentage of academy converter (2015)	0.6041	0.3123	0	1
Percentage of primary schools (2015)	0.6508	0.3475	0	1
Percentage of FSM eligible students (2015)	0.1680	0.1023	0.0137	0.6903
Percentage of White (2015)	0.7830	0.2261	0	0.99
Number of students (2015)	2,463.90	3,861.90	150	35,668
Size (number of schools in MAT; 2015)	5.77	7.21	1	61.00
Observations	391	391	391	391

Notes: sample only includes primary, secondary and all through non-special schools in England. Special schools and middle schools not included. FSM: free school meals. Decentralised (dummy) 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. Decentralisation (standardised) is the standardised average across these items with the coding as described. 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 2007-2009 changes in 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). A MAT is defined as having the majority of schools aligned if more than 50% of schools belonging to the MAT are aligned with the MAT board. Board alignment missing represnts the share of schools within MATs for which we could not reconstruct the background of the school managerial team. Herfindahl index based on the shares of schools in the MAT that are located in different local authorities.

Table 2. Main results

	Dependent variable: extent of decentralisation					
	(1)	(2)	(3)	(4)	(5)	(6)
Distance to frontier	-0.2815***		-0.2421**	-0.2394**	-0.2613**	
	(0.0978)		(0.1083)	(0.1098)	(0.1116)	
School Value Added (VA)		0.1730				0.1418
		(0.1380)				(0.1539)
99th percentile of VA		-0.3585***				-0.3656**
		(0.1135)				(0.1418)
VA heterogeneity	0.2013	0.2408	0.1749	0.1858	0.2365	0.2554
	(0.2267)	(0.2265)	(0.2298)	(0.2349)	(0.2414)	(0.2398)
Age < 25th percentile	0.2308**	0.2361**	0.3195**	0.3403**	0.3633***	0.3532**
	(0.0937)	(0.0923)	(0.1383)	(0.1352)	(0.1376)	(0.1372)
25th < Age < 50th percentile	0.1443	0.1433	0.2025	0.2142*	0.2233*	0.2078*
	(0.0976)	(0.0969)	(0.1267)	(0.1221)	(0.1226)	(0.1231)
50th percentile < Age < 75th percentile	-0.0030	-0.0046	0.0034	0.0337	0.0478	0.0406
	(0.0975)	(0.0964)	(0.1183)	(0.1153)	(0.1166)	(0.1153)
School - MAT board alignment	0.0931*	0.0956*	0.1144**	0.1179**	0.1231**	0.1257**
	(0.0501)	(0.0500)	(0.0539)	(0.0543)	(0.0546)	(0.0545)
Observations	391	391	391	391	391	391
MAT controls	N	N	Y	Y	Y	Y
Teacher controls	N	N	N	Y	Y	Y
LA controls	N	N	N	N	Y	Y
P-value on VA - Distance to frontier		0.2357				0.2482

Notes: Variable description and key statistics in Table 1. All columns control for the share of schools within the MAT for which the board alignment information could not be reconstructed. 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 schools within the MAT; 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 (percentage of White students, percentage of FSM eligible students). Teacher controls include: pupil-to-teacher ratio, average number of teachers, total number of school managers, average teacher age, percentage of female teachers, average tenure. Market level (LA) controls include: share of primary schools; share of community schools; share of sponsored academies; share of converter academies. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3. MAT with monopolistic position

	Dependent variable: extent of decentralisation			
			Keep only MATs:	
	Base	Add Herfindahl	Monopolist on average	Monopolist
	(1)	(2)	(3)	(4)
Distance to frontier	-0.2613**	-0.2533**	-0.2768*	-0.3546***
	(0.1116)	(0.1123)	(0.1615)	(0.1225)
VA heterogeneity	0.2365	0.2299	0.3044	0.2664
	(0.2414)	(0.2401)	(0.2948)	(0.2571)
Age < 25th percentile	0.3633***	0.3926***	0.4208**	0.4532**
	(0.1376)	(0.1476)	(0.1984)	(0.1784)
25th < Age < 50th percentile	0.2233*	0.2478*	0.3657**	0.3852**
	(0.1226)	(0.1304)	(0.1615)	(0.1566)
50th percentile < Age < 75th percentile	0.0478	0.0676	0.1849	0.1453
	(0.1166)	(0.1225)	(0.1500)	(0.1496)
School - MAT board alignment	0.1231**	0.1229**	0.0808	0.1257*
	(0.0546)	(0.0547)	(0.0868)	(0.0753)
Observations	391	391	195	247
MAT controls	Y	Y	Y	Y
Teacher controls	Y	Y	Y	Y
LA controls	Y	Y	Y	Y
Herfindahl index	N	Y	N	N

Notes: Variable description and key statistics in Table 1. All columns control for the share of schools within the MAT for which the board alignment information could not be reconstructed. All other controls as in Table 2. Monopolistic/non-monopolistic markets and MATs defined in the main text - see Section 5.3. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Robustness checks

		Distance to frontier		VA heterogeneity		Alignment measure:			Outcome:
	Base	Average	95th percentile	VA	Percentile of VA difference	Majority		Continuous	Continuous
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Distance to frontier	-0.2613**	-0.2987**	-0.2180	-0.2452**	-0.2706**	-0.2729**	-0.3875***	-0.2505**	-0.5624**
	(0.1116)	(0.1309)	(0.1432)	(0.1117)	(0.1128)	(0.1249)	(0.1422)	(0.1118)	(0.2280)
VA heterogeneity	0.2365	0.1571	0.2204	-0.0084	0.2049	0.2838	0.3267	0.2365	0.3360
	(0.2414)	(0.2382)	(0.2466)	(0.1177)	(0.1881)	(0.2652)	(0.2931)	(0.2424)	(0.4732)
Age < 25th percentile	0.3633***	0.3733***	0.3683***	0.3579***	0.3661***	0.3080**	0.3101	0.3519**	0.7989***
	(0.1376)	(0.1376)	(0.1380)	(0.1378)	(0.1389)	(0.1474)	(0.2220)	(0.1380)	(0.2733)
25th < Age < 50th percentile	0.2233*	0.2292*	0.2352*	0.2238*	0.2399*	0.1763	0.1293	0.2118*	0.4583*
	(0.1226)	(0.1224)	(0.1227)	(0.1225)	(0.1249)	(0.1306)	(0.2138)	(0.1231)	(0.2407)
50th percentile < Age < 75th percentile	0.0478	0.0433	0.0573	0.0506	0.0655	0.0480	0.0229	0.0385	0.1311
	(0.1166)	(0.1179)	(0.1175)	(0.1162)	(0.1185)	(0.1222)	(0.2068)	(0.1170)	(0.2360)
School - MAT board alignment	0.1231**	0.1132**	0.1221**	0.1230**	0.1175**	0.1481**	0.1334*	0.1317*	0.2637**
	(0.0546)	(0.0549)	(0.0547)	(0.0548)	(0.0547)	(0.0612)	(0.0786)	(0.0745)	(0.1147)
Observations	391	391	391	391	391	328	204	391	391
MAT controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Teacher controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
LA controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Schools with alignment missing	Y	Y	Y	Y	Y	< 0.5	0	Y	Y

Notes: Variable description and key statistics in Table 1. All columns control for the share of schools within the MAT for which the board alignment information could not be reconstructed (except for Column 7). All other controls as in Table 2. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

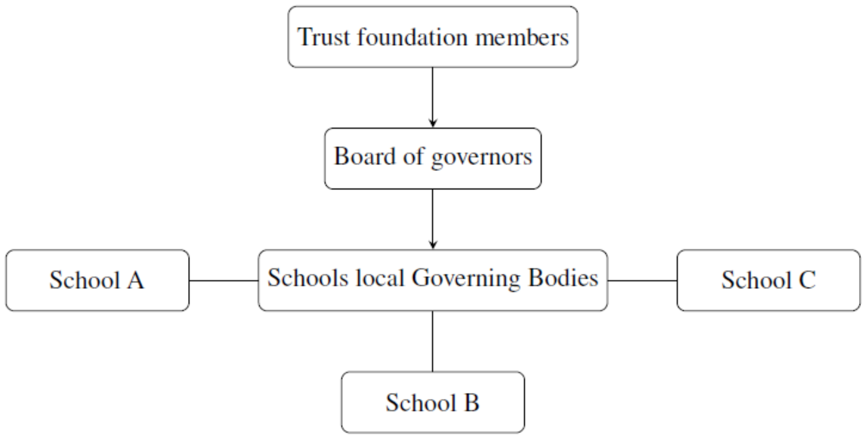
Table 5. Decentralisation and school effectiveness

	Continuous standardised decentralisation			Decentralisation dummy		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. School-level estimates of effectiveness						
Decentralisation	-0.0176**	-0.0121*	-0.0122*	-0.0188	-0.0075	-0.0071
	(0.0071)	(0.0069)	(0.0067)	(0.0145)	(0.0136)	(0.0136)
Observations	1,196	1,196	1,196	1,196	1,196	1,196
Panel B. School-level estimates of effectiveness averaged by MAT						
Decentralisation		-0.0148*	-0.0139*		-0.0053	-0.0007
		(0.0075)	(0.0074)		(0.0157)	(0.0158)
Observations		312	312		312	312
Panel C. Within-MAT dispersion in school effectiveness						
Decentralisation		0.0073	0.0080		0.0324**	0.0321**
		(0.0076)	(0.0077)		(0.0154)	(0.0158)
Observations		227	227		227	227
School controls	Y	Y	Y	Y	Y	Y
MAT controls	N	Y	Y	N	Y	Y
LA controls	N	N	Y	N	N	Y
Clustered SE	MAT	MAT	MAT	MAT	MAT	MAT

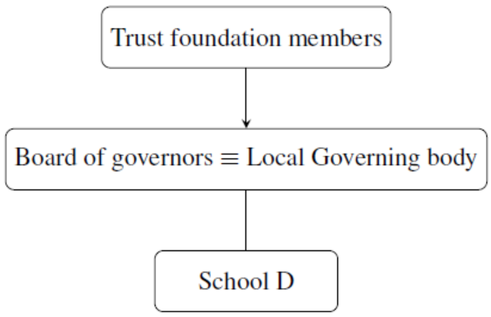
Notes: The Table shows OLS regressions of estimates of effectiveness at school level (Panel A) and MAT level (Panel B) and within-MAT dispersion in effectiveness (Panel C) on two measues of decentralisation. Columns (1)-(3) use a continuous measure of decentralision as defined in the main text; columns (4)-(6) use a dichotomous indicator for MATs that decentralise more than 50% of the procurement activites. Regressions in Panel A are at the school level; regressions in Panels B and C are at the MAT level. Columns (1) and (4) control student for characteristics at school level (number of students, share of white students, share of students eligible for subsidised lunch), type and phase. Columns (2) and (5) add MAT controls: average and standardised age, number of schools in the MAT, number of students in the MAT, herfindahl index, an indicator for MAT with only one school, type of trust (i.e. business or education), share of converter academies, share of primary schools, standard deviation in the number of students, share of students eligible for subsidised lunch and share of white. Columns (3) and (6) add LA controls: share of community schools, share of primary schools, share of converter and share of sponsored academies. School level controls cannot be included in MAT-level regressions of Panel B and C (Columns 1 and 4). They are averaged and included as MAT-level controls in the other columns of the two panels. In Panel A, standard errors are clustered at MAT level. In Panel B and C, standard errors are robust. *** p<0.01, ** p<0.05, * p<0.1

Appendix: Figures

Appendix Figure 1. Governance structure in MATs and SATs



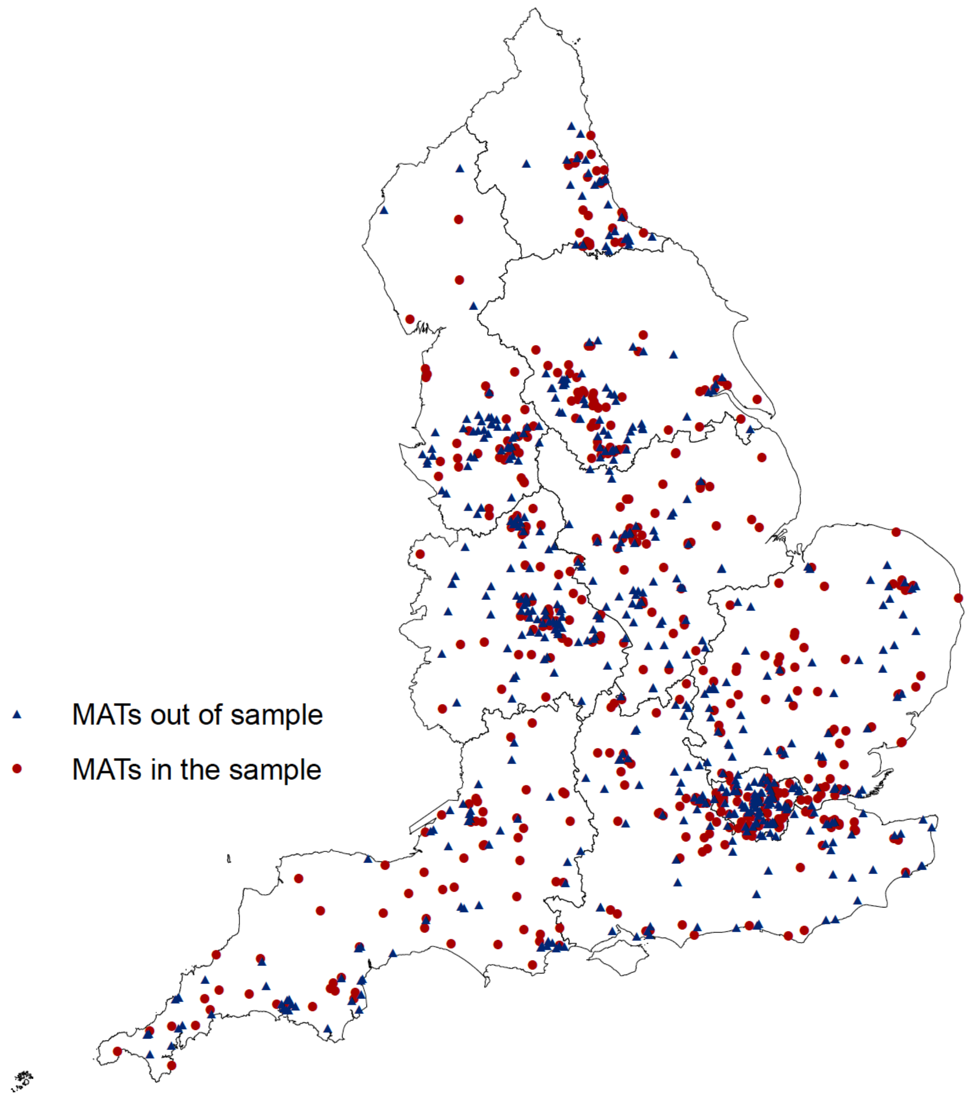
Panel A. Multi-Academy Trusts (MATs)



Panel B. Single Academy Trusts (SATs)

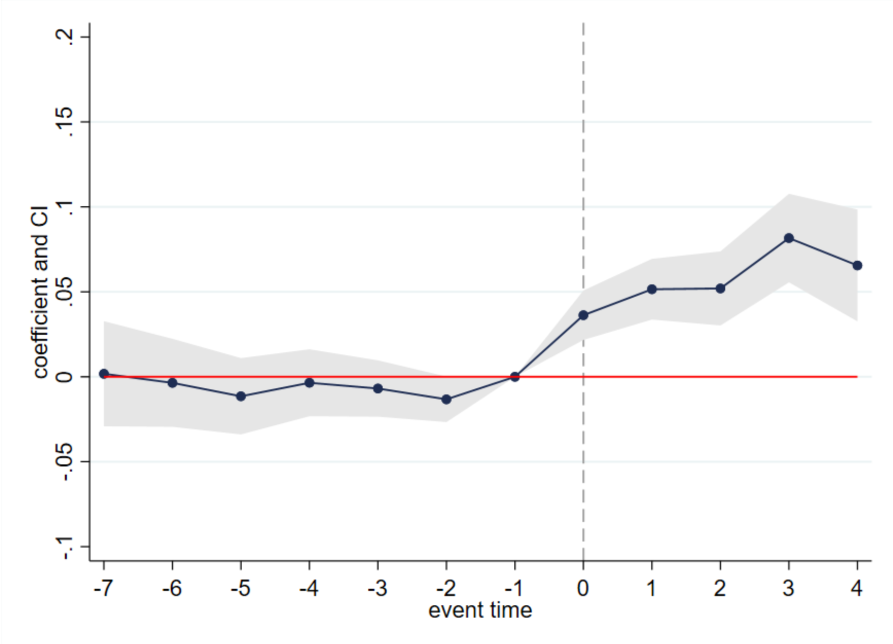
Notes: The figure shows the governance structure in Multi-Academy Trusts (Panel A) and Single Academy Trusts (Panel B).

Appendix Figure 2: The Spatial Distribution of School chains - in and out of our sample



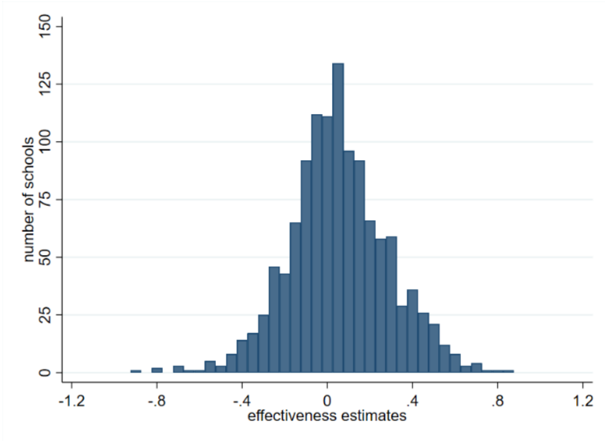
Notes: based on the authors' calculations using MAT headquarters' address (postcode). Solid lines refer to Government regions.

Appendix Figure 3: Event Study

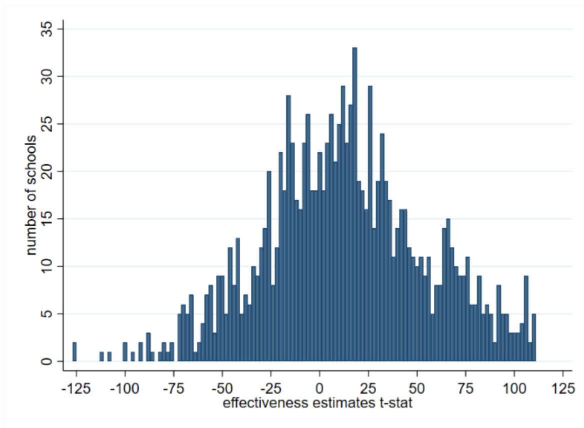


Notes: the figure shows time-specific estimates from a regression of student attainment on an indicator variable for being enrolled in a school belonging to a MAT interacted with event time indicators. The sample only includes 'legacy' students - see main text for details. The specification employed mirrors the one used in Column (3) of Appendix Table 5. Other specifications yield similar results and are available upon request. Shaded area indicated 95% confidence intervals. Standard errors are clustered on schools.

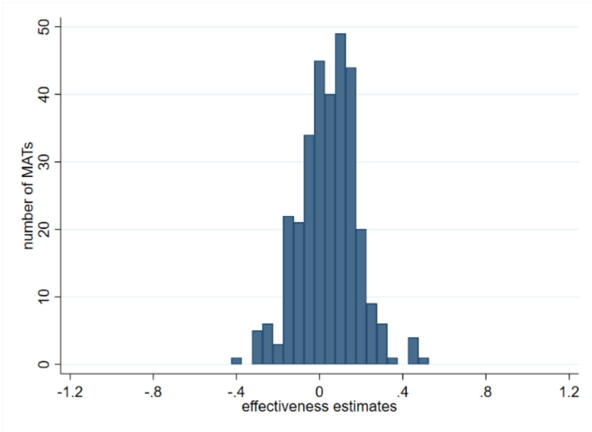
Appendix Figure 4: Distributions of effectiveness estimates and effectiveness dispersion



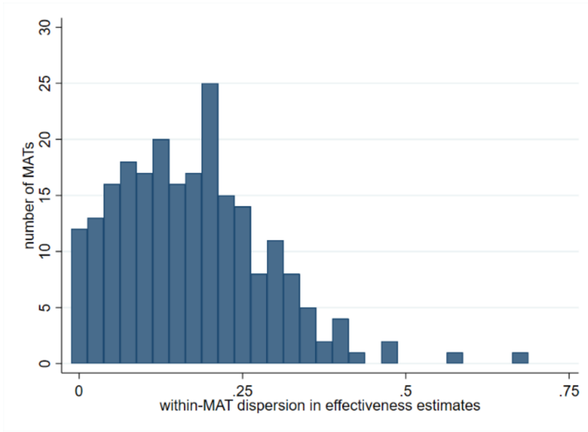
Panel A. School-specific effectiveness



Panel B. School-specific effectiveness t-stats



Panel C. MAT-specific effectiveness



Panel D. Within-MAT dispersion in effectiveness

Notes: the figure shows the distribution of school-specific effectiveness estimates and their T-statistics (Panel A and B, respectively); MAT-averaged school effectiveness estimates (Panel C); and within-MAT dispersion in school effectiveness estimates (Panel D). The estimates were obtained using the same specification as in Column (3), Appendix Table 5.

Appendix: Tables

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

	Mean (in sample)	Mean (out of sample)	Difference
	(1)	(2)	(3)
Size (number of schools in MAT)	5.683	2.550	3.133***
			(0.379)
Number of students	2373.670	1215.194	1,158***
			(189.5)
Percentage of primary schools	0.652	0.814	-0.163***
			(0.0232)
Percentage of converter academies	0.592	0.718	-0.127***
			(0.0248)
Herfindahl index	0.829	0.928	-0.0982***
			(0.0168)
Percentage of FSM students	0.170	0.156	0.0143*
			(0.00846)
Percentage of White students	0.808	0.781	0.0268
			(0.0173)
Percentage of SEN students	0.237	0.147	0.0893***
			(0.00569)
Percentage of English-native speakers	0.863	0.842	0.0204
			(0.0139)
Percentage of males	0.509	0.508	0.00110
			(0.00581)
Average number of students per school	508.109	581.437	-73.33***
			(23.82)
Value added, measured in 2009	-0.051	0.053	-0.104***
			(0.0174)
Percentage of schools judged outstanding by Ofsted	16.644	16.041	0.603
			(1.551)
Percentage of schools judged good by Ofsted	39.863	33.137	6.726***
			(2.256)
Percentage of schools judged requirying improvements by Ofsted	12.324	7.041	5.283***
			(1.212)
Percentage of schools judged failing by Ofsted	5.222	2.927	2.295***
			(0.828)
Percentage of Ofsted inspections NA	25.945	40.856	-14.91***
			(2.492)
Age (months)	47.164	47.188	-0.0244
			(1.862)
Observations	391	351	742

Notes: 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

Appendix Table 2: Comparison between MATs included and excluded in the effectiveness estimation sample

	Mean (in sample)	Mean (out of sample)	Difference
	(1)	(2)	(3)
Size (number of schools in MAT)	6.240	3.481	2.7594***
			(0.4882)
Number of students	2,687.289	1,135.076	1,552.2125***
			(238.2400)
Percentage of primary schools	0.633	0.727	-0.0941**
			(0.0452)
Percentage of converter academies	0.569	0.682	-0.1132***
			(0.0432)
Herfindahl index	0.802	0.937	-0.1349***
			(0.0243)
Percentage of FSM students	0.170	0.173	-0.0031
			(0.0166)
Percentage of White students	0.806	0.818	-0.0125
			(0.0298)
Percentage of SEN students	0.240	0.222	0.0182*
			(0.0107)
Percentage of English-native speakers	0.863	0.861	0.0020
			(0.0257)
Percentage of males	0.507	0.519	-0.0119**
			(0.0060)
Average number of students per school	526.290	436.303	89.9870***
			(32.7366)
Value added, measured in 2009	-0.053	-0.043	-0.0107
			(0.0269)
Percentage of schools judged outstanding by Ofsted	15.773	20.085	-4.3121
			(2.9786)
Percentage of schools judged good by Ofsted	39.002	43.265	-4.2626
			(3.7646)
Percentage of schools judged requirying improvements by Ofsted	13.096	9.276	3.8196*
			(2.2140)
Percentage of schools judged failing by Ofsted	5.254	5.097	0.1561
			(1.6001)
Percentage of Ofsted inspections NA	26.873	22.277	4.5962
			(3.3517)
Age (months)	53.622	21.658	31.9636***
			(2.6190)
Observations	312	79	391

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

Appendix Table 3. Business Orientation and School Resources

	(1) Total expenditures	(2) Teaching staff	(3) Educational support staff	(4) Development and training	(5) Learning resources	(6) ICT resources	(7) Back office	(8) Government funds	(9) Income from facilities/services
Panel A. Schools									
Share with business background	0.0086	0.0068	0.0002	0.0274	0.0303**	0.0129	0.0178*	0.0054	0.0713*
	(0.0084)	(0.0080)	(0.0124)	(0.0211)	(0.0145)	(0.0311)	(0.0107)	(0.0084)	(0.0431)
Observations	1,532	1,532	1,530	1,522	1,532	1,500	1,532	1,532	1,512
Panel B. MAT									
Business-oriented board	0.0576	0.0656	0.0032	0.1694*	0.0186	0.0463	0.1094	0.0549	0.1670
	(0.0658)	(0.0666)	(0.0657)	(0.0948)	(0.0826)	(0.1005)	(0.0727)	(0.0613)	(0.1330)
Observations	388	388	388	388	388	388	388	388	388
Student characteristics	Y	Y	Y	Y	Y	Y	Y	Y	Y
School characteristics	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: Dependend variable: log of expenditure or income category. All columns control for total number of students, number of White, FSM eligible, SEN and male students, school phase and academy type (converter or sponsored). Panel A controls for these characteristics at school-level, while Panel B uses MAT-level aggregates. The share of member of the school local governing board with a business background (Panel A) is standardised to have zero mean and unit variance. Standard errors are corrected for within-MAT correlation in Panel A and for heteroskedasticity in Panel B. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 4. Decentralisation Decisions for Single Procurement Items

		Extent of decentralisation in:						
	Base	Assessment	Professional Development	ICT	Curriculum	Teaching equipment	Staff	Utilities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Distance to frontier	-0.2613**	-0.1888*	-0.2541***	-0.2053**	-0.0792	-0.1062	-0.1669*	-0.2089**
	(0.1116)	(0.1028)	(0.0970)	(0.1021)	(0.0901)	(0.0851)	(0.1003)	(0.1038)
VA heterogeneity	0.2365	0.2754	0.0872	0.1065	-0.0121	-0.2098	0.1942	0.2501
	(0.2414)	(0.2251)	(0.2215)	(0.2180)	(0.1939)	(0.1761)	(0.2274)	(0.2274)
Age < 25th percentile	0.3633***	0.1800	0.0987	0.3888***	0.2258**	0.1563	0.2084*	0.4513***
	(0.1376)	(0.1306)	(0.1221)	(0.1122)	(0.1115)	(0.1018)	(0.1170)	(0.1222)
25th < Age < 50th percentile	0.2233*	0.0929	0.0252	0.2303**	0.1545	0.0731	0.1015	0.2908***
	(0.1226)	(0.1128)	(0.1093)	(0.1020)	(0.1016)	(0.0904)	(0.1034)	(0.1061)
50th percentile < Age < 75th percentile	0.0478	0.0190	-0.0745	0.1063	0.0619	-0.0278	0.0137	0.1599
	(0.1166)	(0.1079)	(0.1042)	(0.0974)	(0.0972)	(0.0876)	(0.0961)	(0.1007)
School - MAT board alignment	0.1231**	0.0707	0.0599	0.0761	0.0794*	0.1000**	0.0969**	0.0911*
	(0.0546)	(0.0499)	(0.0471)	(0.0488)	(0.0436)	(0.0419)	(0.0480)	(0.0500)
Observations	391	376	389	390	390	390	390	390
MAT controls	Y	Y	Y	Y	Y	Y	Y	Y
Teacher controls	Y	Y	Y	Y	Y	Y	Y	Y
LA controls	Y	Y	Y	Y	Y	Y	Y	Y

Notes: Variable description and key statistics in Table 1. All columns control for the share of schools within the MAT for which the board alignment information could not be reconstructed. All other controls as in Table 2.Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 5: MAT Membership and Student

	Dependent variable:						
	Value-added		Test scores				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Policy on	0.0556***	0.0594***	0.0553***	0.0555***	0.0502***	0.0299***	0.0595***
	(0.0084)	(0.0086)	(0.0077)	(0.0077)	(0.0076)	(0.0081)	(0.0091)
Observations	3,412,870	3,369,273	3,369,273	3,369,273	3,369,272	2,503,384	3,369,272
School FE	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y
Student controls	N	Y	Y	Y	Y	Y	Y
Value-added	Dependent	Dependent	Baseline scores	Baseline scores	Baseline scores	Baseline scores	Baseline scores
LA time trends	N	N	N	Parametric	Non-parametric	Non-parametric	Non-parametric
Clustered SE	School	School	School	School	School	School	School
Conversion year	Join year	Join year	Join year	Join year	Join year	Open year	Join year
Strategy	Reduced-form	Reduced-form	Reduced-form	Reduced-form	Reduced-form	Reduced-form	Instrumental V.
Sample	All	All	All	All	All	All	All

Notes: The table shows estimates from regressions of student attainments on an indicator variable for being enrolled in a school belonging to a MAT. Sample only includes 'legacy' students - see main text for details. Columns (1)-(2) use value-added as dependent variable. Columns (3) to (7) use test scores at the end of primary or secondary school and control for baseline score at KS1 and KS2 respectively. All columns control school, year and event time fixed effects. Columns (2) to (7) also control for student gender, ethnicity and free school meals indicator. Column (4) adds LA-specific time trends; columns (5) to (7) add LA-year fixed effects instead. Column (6) uses schools' year of conversion to academy instead of the year in which they joined a MAT. Appendix Table 4 presents a cross-tabulation of the two dates. Column (7) instruments enrolment into MAT schools at the time of the test with an indicator for being 'legacy' enrolled in a MAT school. More details are provided in the main text. Standard errors are clustered on schools. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 6: Year of conversion vs year in which schools join a MAT

	Open Year															
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Join Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
2003	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2004	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
2005	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
2006	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	8
2007	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	14
2008	0	0	0	0	0	0	31	0	0	0	0	0	0	0	0	31
2009	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	41
2010	0	0	0	0	0	0	0	0	55	0	0	0	0	0	0	55
2011	0	0	0	0	0	0	0	0	0	198	0	0	0	0	0	198
2012	1	0	0	0	0	0	0	0	1	0	319	0	0	0	0	321
2013	0	0	0	0	0	0	1	0	0	0	0	388	0	0	0	389
2014	0	0	0	0	0	0	0	0	0	0	1	0	371	0	0	372
2015	0	0	0	0	0	3	0	0	7	11	16	9	5	277	0	328
2016	0	0	0	0	0	0	0	0	0	9	0	1	3	1	157	171
Total	1	2	2	1	8	17	32	41	63	218	336	398	379	278	157	1,933

Notes: The Table shows a cross-tabulation of the year in which each school in the final sample became an academy ('open year') and the year in which the school joined a MAT ('join year').

Online Appendix

Table 1: Mapping between occupations and groupings

Link

Table 2: Mapping between degree types and groupings

Link