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The organizational economics of school chains

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Abstract
We use the insights of firms' organizational economics to study school chains' organization. We match information on decentralization of activities for approximately 400 chains and 2,000 schools in England to student and school administrative records. Chains with a larger share of schools whose leadership background is aligned with the chain's expertise, younger chains, and chains close to the productivity frontier decentralize more. We investigate the link between decentralization and school performance – and find no association. This is consistent with the intuition that chains choose structures that maximize students' learning, so the equilibrium relationship between performance and organizational set-up is flat.

Keywords: school chains, school autonomy, organizational economics, incomplete contracts
JEL: 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 March 2022 Government White Paper – setting out the official education policy agenda – envisioned that all schools would be part of a chain by 2030.[1]

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. 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.[2]

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 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

[1] In 2019, nearly 7,500 US charter schools educated 7% of the student population; approximately 25% of these schools were in chains. In Sweden in 2021, 15% of primary/middle school students and 28% of secondary school pupils attended an autonomous friskolor – and that 40% and 66% of these schools were part of chains.

[2] Sweden and the UK operate a system in which money follows pupils, so pupil roll is an important determinant of resources. US Charter schools are paid a 'charter fee' per pupil enrolled, creating a tight link between student numbers and funding. In Sweden and the US, chains can be run for profit, while this is not the case in the UK.

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. 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.[3] Malenko (2023) provides an extensive review of the literature – focussing on the trade-offs between incentive alignment and information flow. 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 predictions that can be taken to the data. First, a higher degree of congruence in preferences between principals and agents increases decentralisation by reducing 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 principals is limited so that they cannot identify the 'right technology' to deliver the best education standards, decentralisation is more likely to occur. Paraphrasing Acemoglu et al. (2007), such cases prevail when: *i*- the chain operates schools that are close to the education technology frontier because the principal (i.e., the chain 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.[4]

To test these predictions, we use detailed survey information collected in 2016 on the decentralisation decisions of procurement activities for approximately 400 chains (roughly 60% of all chains that existed then) and 2,000 schools. These variables are measured at the chain 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[5] and information from school, teacher and

[3] Bloom et al. (2014) study the role of information and communication technology (ICT) on firm organization. They show that better information technologies lead to more autonomy for managers, while investments that improve communication foster centralisation. We cannot study these issues in our context as we do not have access on specific ICT investment items for schools and chains.

[4] The literature provides other insights – for example on the role of an organization's size or its geographical spread. We return to these predictions when we discuss our findings.

[5] We constructed these records using UK Companies House. More details are provided in Section 3.

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 schools with whom they compete and 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 chain board members, and classify chains as run by 'businessmen / economists' or 'educationalists'. We then use information on the background of school head-teachers and the 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 school management team's training with 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 captures more directly the alignment in terms of objectives and philosophy between chain 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 chain. 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 chain is present. Finally, we identify the age of the chain using the date in which its first school joined.

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. While levels of achievement are heavily influenced by factors other than a school's contribution (e.g., family background), value-added measures are more broadly accepted in the education literature as good proxies for school productivity. In the English context, school value-added metrics are also associated with parental 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 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 value-added as a key driver of a chain's decentralisation decision – thus assuming that this is paramount to school choice, pupil roll and schools' and chains' financial viability. Gibbons and Silva (2011) provide

evidence that value-added measures of school quality dominate parental satisfaction with schools – over and above child wellbeing at school. Of course, it is possible that chains consider other objectives when choosing their structures – and 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. Nonetheless, we return to this issue below and provide clear evidence to support our assumption. Lastly, we identify the markets in which the chains operate as the LAs where 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 – and remain financially viable.

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 endogeneity concerns. To begin with, we measure school and chain characteristics in 2009. This is before a set of policies implemented in 2010 by a newly elected Coalition Government paved the way for a swift expansion of chains in England. Prior to this change, a total of 56 chains opened between 2002 and 2009 (there were no chains before 2002). In contrast, 45 chains opened in the academic year 2009/2010 – even if only the last three 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 sector also helps identify the impact of attributes that are exogenous to schools' decisions to join chains: the reforms that led to the swift increase in pervasiveness of chains were unexpectedly introduced in June 2010 and many schools were 'urged' (to say the least) to join chains – irrespective of their characteristics. This push was driven by political considerations and a desire of the centre-right Government to strengthen autonomy and competition in state-education. Indeed, we provide evidence showing that schools that join chains are broadly comparable to schools that remain stand-alone academies. Nevertheless, it still be possible that schools select to join chains (or chains accept schools) based on attributes that make them more compatible with a chain's structure. For example,

more technologically advanced (high value-added) schools could join 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 holds a monopolistic position (i.e., only one chain was present or held a dominant share of the market) and schools have virtually no choice in terms of which network to join (when pushed to do so by the new policies). 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 chains. We show that increasing the share of schools in the chain whose leadership training is aligned with the board background 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 test our assumption that chain's structures are driven by decisions aimed at maximising value-added (i.e., 'output') at the organisation level. To do so, we study the association between chain's structures and their students' performance: if chains choose their organization to maximize students' learning, the equilibrium relationship between chains' average performance and organizational set-up should be flat.

To operationalise this idea, we start by estimating the effect of being part of a chain on attainment value-added. To do so, we focus on 'legacy' students who were enrolled at schools before these joined a chain and use a differences-in-differences (DiD) analysis that compares 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 chain; *(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, 2023). 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' value-added is about 5% of a standard deviation higher once a school joins a chain. To corroborate our findings, 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 being part of a chain – and use these to create measures of the average effectiveness of different chains. Our results show that there is considerable variation in chain average effectiveness. However, this variation is not significantly related to our proxies for whether the chain has more or less decentralised decision making. We believe 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) within the group – so the equilibrium relation between performance and organization is flat.

The flat relationship between decentralization and school effectiveness could also betray a lack of impact of chains' organizational structures on performance. To dispel this possibility, we conclude our analysis by studying whether the association between decentralization and effectiveness is flat for all schools within a chain. We find that this is not the case: for schools that are weaker and potentially mismatched to chains they belong to, we find a negative association between decentralization and performance. 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 organization.

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). Galiani et al. (2008) investigate the tension between decentralisation and 'voice' (i.e., parents' ability to defend their preferences) and find that decentralisation is mostly beneficial for good schools (see also Galiani and Shargrodsky, 2002).[6] Closest to our research is a set of papers by Bryson et al. (2018, 2020, and 2023) who focus on leadership, human resources (HR) management and performance in English schools. Specifically, Bryson et al. (2018) investigate whether academies have more complex school-level managerial structures and whether this affects student performance. However, the authors

[6] Behrman and King (2001) provide a framework that conceptualises the tension between choice and voice and analyse the impact of decentralisation. Relatedly, Gertler et al. (2006) and Jimenez and Sawada (1999) study the effect of parental involvement and community-managed schools on students' performance.

do not study how decentralisation decisions of chains respond to the same trade-offs faced by firms – namely, the balance between alignment of goals and information diffusion. In this sense, 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 work also relates to a large literature on the effectiveness and functioning of charter schools – summarised by Cohodes and Praham (2021). Their survey suggests that charter management structures are important for pupil outcomes and that not-for-profit chains (Charter Management Organization, or CMOs) perform better than for-profit ones (see also CREDO, 2017). Our research takes a novel approach to these issues by investigating whether the choices made by chains regarding their organizational structures respond to the same trade-offs that characterise firms' decision-making.

Our results have strong relevance as they speak to ongoing debates about the applicability of quasi-markets 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 react to different motives and in ways that cannot be represented by economic models. Our evidence shows otherwise – and 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. At least in the context of the English drive to 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, 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.[7]

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 is further organised around five stages referred to as Key Stages (KS). In primary

[7] The literature on school competition is large; see Foliano and Silva (2020) for a review. Amongst others, Hoxby (2000) presents one of the first studies for the US, while Gibbons et al. (2008) provide evidence for the UK.

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. KS1 exams are externally set, but internally marked by teachers. At KS2, students take standardised national tests in English, Mathematics and Science, which are externally assessed. At KS4, pupils sit for national tests in a range of subjects, although English, Mathematics and Science are compulsory. These tests are externally assessed. School average attainments at 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 normally 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. While Ofsted is a 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 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 admission tests (Grammar schools). Depending on where they live, families can apply to between three and six schools. To allocate pupils to schools, the LAs run constrained versions of student-optimal stable mechanism – known as Deferred Acceptance algorithm. State-funded schools enrol just below 95% of all students – with around 5% of the students opting for private education.

2.2 School types and the academies programme

There are five school types in England: community, voluntary controlled, foundation, voluntary aided and academy. Community and voluntary controlled 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 activities). The local governing bodies (LGBs) of these schools include members of staff, representatives of the LA and parents. Voluntary aided and foundation schools enjoy more autonomy from 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 the central government through general taxation.

Academies enjoy far more autonomy than any of the other 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, 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 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 Labour in 2002 to tackle underperformance by imposing organizational restructuring and 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 standards. The programme dramatically changed in May 2010 with the election of the new Conservative/Lib Dem 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.[8] Since 2010, the academisation process grew dramatically –

[8] A key incentive 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

especially during the 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 Chains and their structures

During the Labour Government, all sponsor-led academies had to join a chain. However, following the 2010 reforms, converter academies could decide to incorporate as a single-academy trusts – with a governing body taking on full managerial responsibilities alongside the headteacher and his/her team (sponsor-led academies still had to join a chain).

Such stand-alone academies embody the idea of a fully decentralised system in which each autonomous school is responsible for all its decisions and services. On the other hand, chains are more complex structures in which school autonomy and central control coexist. In principle, chains have a single governing body – the 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 chain therefore share the same Board of Directors, which can take up most of the tasks normally performed by the LGB of individual schools.[9] Online Appendix Figure 1 shows a visual representation of school chains' governance structure.

The foundation members of the chain (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.[10] Greany (2018) finds that, while all chains are 'aspirational' – i.e., aimed at delivering high standards of students' learning – their visions are disparate and grounded in specific missions. Some chains are performance driven, focussed on data and on quantifiable Key Performance Indicators. Others reflect broader objectives such as embodying a specific curriculum-related philosophy (e.g., Montessori); or adhering to specific pedagogical approaches – such as restorative practices.

Headteachers are instead selected through a formal process that requires the appointment of a panel, normally comprising at least three members of LGB and taking into account equity

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 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.

[9] The chain 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).

[10] 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.

and diversity considerations. Headteacher positions need to be widely advertised (ideally at the national level) and schools are encouraged to get advice and support on salary considerations; the person specification; and administrative matters whenever they lack the relevant expertise. The selection process includes a shortlisting stage; the reviewing of reference letters; and a visit day during which candidates are 'tested' (this includes giving a presentation, teaching a lesson, talking to pupils and potential colleagues). To some extent, academies and chains can deviate from these guidelines – having more freedom to decide on the composition of the panel. However, they are advised to follow similar procedures and required to spell out in details their recruitment approach.[11]

Although the Board of Directors in principle sets the direction for the chain and its schools, hold headteachers accountable, and ensure financial probity, Trustees can delegate functions to headteachers of the schools. This is done through publicly verifiable 'schemes of delegation' – normally applying to all schools within the chain. This means that functions and operations can be delegated and attributed to different actors along the governance chain.[12]

Before concluding, it is worth briefly discussing chains' funding model. To support their activities, chains '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 chains charge a 'fixed rate', namely the same percentage of the budget applies to all schools. However, some chains 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 chains operate as charities, these funds are not used to achieve a profit (chains 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 chains 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 – and 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

[11] See DfE (2017) for more details. Most headteachers come from within the profession though not necessarily from within the school or chain. They are normally senior teachers or headteachers who has shown outstanding teaching and management skills and a strong commitment to the profession.

[12] Unlike the literature on firms' organization, we do not consider issues that arise due to the multi-divisional nature of chains (i.e., the presence of many schools within the organization; see Malenko, 2023). This is not a major omission: as clarified, chains take decentralisation decisions that normally apply to all schools within the organization. Similarly, we abstract from dynamics and questions of optimal timing of delegation choices.

chains are remunerated. Some recent media 'scandals' (2019-2020) uncovered some CEOs' pays in excess of £250,000 per year.[13]

2.4 Chains' objectives and incentives

Chains' financial viability is linked to the number of pupils enrolled in their schools – as resources follow students in a school choice system. Available evidence for England suggests that parental preferences are shaped by elements of school quality that relate to students' rate of progression. For example, Gibbons et al. (2013) show that school value-added metrics are capitalised into house prices, and Gibbons and Silva (2011) provide evidence that value-added measures of school quality dominate parental satisfaction with schools – over and above child wellbeing at school, enjoyment of the learning environment, and peer composition. Therefore, we envisage chains' objectives as targeted at delivering education quality that can influence parental preferences – i.e., students' learning and progress through the Key Stages.

The broader institutional context supports this view: chains can be closed down because of underperformance (often leading to financial insolvency because of drops in students' roll). Specifically, when the DfE identifies poor standards, it first issues a 'Note to Improve' to the Board of Directors and – if no improvements materialise – it proceeds to close the chain by issuing a 'Termination Notice'. Schools within the group are then reassigned to other chains. DfE official data show that between 2012 and 2016, more than 160 chains received a warning or a termination letter because of poor performance; Carr (2020) reports that a quarter of all notices sent in the second half of 2019 were addressed to chains where standards had dropped considerably as a result of excessive expansion.

It is possible that other considerations shape chains' objectives – although the institutional set-up within which they operate does not strongly back such alternatives. For example, chains might try to maximise their budgets to remunerate their directors and CEOs. This is unlikely. Chains operate as charities and directors are unpaid. Only CEOs are remunerated – but (as discussed above) their pay is monitored in the media and by the DfE, and excessive pay sanctioned. We also note that for this channel to operate, chains would still plausibly target elements of their provision that can sway parental preferences – i.e., students' progress through the Key Stages – so that they can attract pupils and resources. Similarly, targeting capacity – without filling schools with students – would incur costs without revenues in a system where money follow students. One last possibility is that chains target levels of achievements – instead

[13] To continue the parallel with companies, note that the Foundation Members are the chain 'owners' (the term poorly applies given chains' charitable status) and can decide to wind up the Trust (i.e., close the company).

of value-added. Although previous research suggests that parental choices are sensitive to value-added metrics, there is also evidence showing that they respond to peer composition and attainment levels. We confront this issue empirically below – where we show that chains' organizational structures are much more closely tied to measures of productivity constructed using value-added measures than alternatives based on test score levels.

What are the incentives of schools' headteachers and their local leadership teams? Once again, the institutional context suggests that they should similarly target students' progress. Nonetheless, headteachers could take a shorter-term perspective and try to expand school roll because this positively reflects on their reputation – irrespective of its longer-term impact on standards, resources and viability. Such 'empire building' incentives have been documented in the case of private firms – and could be at play in the English context given the evidence on head-teachers' school mobility and salary premia (see Telhaj et al., 2022). These considerations mean that, when we investigate the alignment of preferences between principals and agents, two mechanisms might be at play. First, chains' directors and school headteachers might be targeting different objectives. Second – even when they share common goals – they might have different views about the best practices to deliver those aims (e.g., a data-led vs. a holistic approach to improving standards).

2.5 The rise of school chains

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

The academisation drive brought about by the new Government 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 chain. The remaining 1300 schools instead switched via the converter route – and mostly set off as stand-alone academies. However, a 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 chain right away, while the remaining chose to become converter academies. Like for secondaries, an

increasing share joined a chain. The Department for Education (DfE, 2016a) puts the overall share of academies in chains at around 70% – with nearly half of all converters and virtually all sponsor-led in a chain. 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 chain – 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 chains opened – i.e., 80% of the total number of chains that opened under the Labour between 2002 and 2010. In the three subsequent 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 chain sector? Using the words of a key stakeholder who manages the largest chain advocacy group, "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 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 join a chain. This was true for primary schools – whose small size implied they would be unable to operate without the LA support – as well as secondary schools that were not outstanding according to Ofsted (i.e., Ofsted had possibly identified some managerial shortcomings). The academisation drive was so incisive that in 2016 the Government briefly held an ambition to make all schools academies. The plan was dropped because of opposition by teachers and parents but reintroduced in March 2022 – when the Government reinstated the ambition to see all schools become academies and join a chain by 2030.

As the number of chains grew, their geographical representation was supposed to evolve. While initially chains focussed on schools in specific LAs, the Government 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 still tended to mostly operate in tight geographical clusters – with schools located within an LA or within an hour-travel distance. Only, the largest chains – 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 samples

3.1 Data

To carry out our investigations, we combine newly collected data and administrative records on students and schools.

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 and provider sector (i.e., mostly schools). The association provides its members 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 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 and tailored advice based on the findings from research conducted by BESA on the data and had an interest in providing meaningful answers. The 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). However, the data was supplemented with information on chain 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.

Chain governance. We web-scraped the UK Companies House website to extract data on the board composition of chains. 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 includes a company's address, date of incorporation (and potentially dissolution), accounting data, and details on current and resigned directors. For each director, we 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 chain board members. Online Appendix Lookup Table 1 presents the full job-expertise lookup table. Below we describe how we use this information to construct a measure of preference congruence between the Board of Director and the school local management team.

School-level and chain-level data. We use publicly available data on school and chain characteristics accessible from 'Get information about schools' – an open-access repository covering all schools in England. These 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 chain, and education phase. We 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 the 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 2015. The data include information on roles held (e.g., head-teacher, class-teacher, IT technician), 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. Each individual is linked to information on the levels of education 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 ethos is aligned with that of the chain. 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. 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.

Decentralisation measures. 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. We exclude information on facilities maintenance as this variable has several missing observations (approx. 20%).[14] Chains 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 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 the chain) 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 considered. We also create a continuous version of this variable obtained by taking the chain-specific average of the decentralisation decisions on the seven activities listed above, and standardizing this variable within our sample. Finally, in some checks, we consider decentralisation of the underlying items contained in our indicator.

Preference congruence. To construct our proxy, we use data from SWF on teacher education and from UK Companies' House on chain Directors' expertise. Considering first the SWF, we proceed as follows. 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.[15] Next, 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 Lookup Table 2 provides the mapping between degree types and groupings. To provide some examples, we classify as education the following degrees (amongst others): 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

[14] Results obtained including facilities are similar to the main ones presented below.

[15] 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.

a private-sector oriented group; and in education if they have all degrees in education – and none in a private-sector oriented subject. This definition is meant to account for the fact that individuals working in education need to have at least one education-related degree – and so we take a single-degree in private-sector oriented areas 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 the data from the UK Companies' House, we first classify individuals as 'clergy', 'army', 'education', 'business', 'mixed' and 'don't know'. The first two categories are self-explanatory. The others are not – so we discuss some common occupations that fall into these groups (Online Appendix Lookup Table 1 details the mapping between occupations and groupings). Starting with education, this group includes individuals who are headteachers, teachers, education consultants – as well as those who work as university lecturers, 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 had retired or had no occupation. To identify the orientation of a chain 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 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 dichotomous variables across schools in the chain represents the fraction of schools that share the same ethos as the chain Board of Directors. In our analysis, we use this continuous proxy as well as a dummy that identifies chains where the majority of schools (i.e., 50% or more) shares the same ethos as the chain Board.

Two 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. This change did not affect our findings. Second, we measure these proxies in 2009 and 2015. 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.

Information diffusion proxies. To construct these variables, we follow Acemoglou et al. (2007). 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 chain Board of Directors) is less likely than the agent (the headteachers and their local team) to identify the best course of action.[16] Adapting their framework to our context, such cases are likely to occur when: *i*- the chains operate schools that are close to the technology frontier and the Board cannot use other chains' experience to guide decision-making; *ii*- the chains operate in heterogeneous environments making it difficult to learn cutting-edge technologies from others; and *iii*- the chains are young and unable to adapt others' technologies to their 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. Using this data, we proceed as follows. First, we average students' value-added within schools – i.e., we calculate each school's average value-added. Second, we identify the 10^{th}, 90^{th} and 99^{th} percentiles of the LA-specific value-added distributions separately for primary and secondary schools. Third, we identify each schools' value-added distance from the 'technological frontier' as measured by the 99^{th} percentile of the value-added distribution in the LA in which the school operates and for the relevant phase (primary or secondary).[17] Next, for each school we compute heterogeneity in technology by measuring the 2006/2007 to 2008/2009 change in the difference between the 90^{th} and the 10^{th} percentile of the value-added distribution in the relevant LA and

[16] 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 focus the curriculum around cross-cutting theme (e.g., the concept of 'individual freedom' in literature, history, and science) or across parallel pillars.

[17] As discussed, 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. It is still possible that schools and chains compare themselves to a subset of schools with similar traits. Our approach abstracts from this possibility.

education phase. Finally, we collapse this information at the chain level for all schools within the group 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 chain 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 a chain's decisions. 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 chains using indicators that identify the age quartile to which they belong.[18]

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' chains (i.e., chains with at least two schools) that existed at the time, approximately 450 completed the survey. We lose observations because of missing information on school and chain characteristics that are key to our analysis, as well as in the data we aggregate up from the NPD. We therefore end up with 391 chains including 2,049 schools. Although our sample is geographically representative of the chain population (Online Appendix Figure 2), chains in our sample are larger, have fewer primaries and more sponsor-led academies than the population (see Online Appendix Table 1). Furthermore, chains in our sample have more deprived student intake and lower achievement. While not fully representative, these patterns suggest that 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 decentralization of activities.

When we study chains' effectiveness, 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. We only make use of 'legacy' students who were already enrolled in schools before these decided

[18] We experiment with several variants of all these proxies to assess the robustness of our results.

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).[19] Online Appendix Table 2 shows that the 312 chains (out of 391) that we retain for this analysis are larger, have more students, tend to be older, and have lower shares of primaries and converter academies.

4. Empirical methods

4.1 The determinants of chains' decentralisation decisions

In the first part of our paper, we investigate the determinants of chains' choices to decentralise their decision making. Using the data described above, we estimate this 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 chain Board of Directors and the school management team; $InfoProxies_i^k$ is one of the k variables that measure the amount of information diffusion in the market and the relative technological position of the schools in the chain; X_i is a set of school, chain 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 chain-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-chain variation, we treat ε_i as a potentially heteroskedastic error term and apply robust standard errors.

There are several challenges to estimating the effect of chain attributes on decentralisation. First, we need to address issues of reverse causality. To deal with this problem, we measure our key proxies in 2009 – while information on decentralisation decisions was recorded in the autumn of 2016. 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 chains in England. Characteristics measured in 2009 are therefore pre-determined to decentralisation decisions – and to the rise of chains – and reverse causality issues should be minimal.[20]

[19] The decision to exclude smaller schools is inconsequential for our analysis. Results including all schools provide similar conclusions and are available upon request.

[20] 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.

The sweeping policy change also helps dealing with two further issues. One concern is that only certain schools joined chains, or that schools manipulated their characteristics to join a chain (or remain independent). As discussed, this is unlikely: the Government 'urged' (some would say 'forced') as many schools as possible to join a chain as soon as possible – and irrespective of their characteristics (e.g., performance or composition). Online Appendix Table 3 shows that the attributes of schools that join chains – including elements of their composition and value-added – are broadly similar to those of schools that remain stand-along academies (most variables we consider are balanced and any significant difference is small in size). This suggests that school self-selection into / out of the chain sector is not a significant concern.

Nonetheless, it is still possible that schools select to join specific chains because they have characteristics that make them more compatible with the chain 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 between school attributes and chain 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 – while pushed to do so by the Government – so their characteristics are likely to be orthogonal to any underlying tendency of the chains to be more / less centralised. We find that this analysis confirms our main evidence.

Last, we include an extensive set of controls to our regressions to isolate as best as we can the channels we are interested in. Specifically, we control for traits of the schools within the chain (e.g., student composition), features of the chain (e.g., size, geographical spread and balance of converter / sponsor-led academies), and market characteristics (e.g., the incidence of chains and the shares of academies). Notwithstanding all the steps we take to mitigate possible confounders, our study has no 'strong identification' claims to make. Instead, our contribution is to provide the first exploration of the applicability of the organizational economics of firms to school chains – bringing together two 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 chain on achievements. To do so, we devise a DiD strategy that focuses on 'legacy' students who were enrolled at the school before this joined a chain. This approach has been used to study the impact of academisation in England (see, Eyles and Machin, 2019; Bertoni et al., 2020; and Neri and Pasini, 2023) and allows us to by-pass the potential endogeneity of pupils' school choice in relation to a school's decision to join a chain.

We focus only on schools that are part of our core sample of academies that are in a chain by 2016 – when the BESA survey was conducted. This means we are not identifying chain effectiveness by comparing schools that join chains to those that do not – but by comparing changes in performance over time for schools that join earlier/at a later stage. Our identification exploits variation that comes from student attainments at the end of primary or secondary school conditional on prior achievements (i.e., value-added) across: *(i)* pupils who start their education in schools that 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 chain; *(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 our time window (our attainment data stops in 2014/2015, but we sample schools that join a chain by the autumn of 2016).

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)* act as controls for schools and pupils in the other groups – stacked by the academic year in which they join a chain. 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.[21] This approach is similar to the one followed by Deshpande and Li (2019). In practice, we estimate the following equation:

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

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*; $Chain_{st}$ 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 (either

[21] School fixed effects are also re-defined to be event specific.

linear or non-parametric trends); and finally ϵ_{islct} is an error term that we allow to be correlated across time within schools and so we cluster standard errors at the school level.[22]

In our main analysis we focus on legacy students and $Chain_{st}$ 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. 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 chain by estimating the following equation:

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

Where most terms were defined above and the expression inside the summation identifies school-specific chain effects $\hat{\delta}_s$ obtained by interacting the $Chain_{st}$ treatment with school dummies.[23] 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 chain m, and the standard deviation of school-level effectiveness ($\hat{\delta}_s$) across schools within the same chain.[24] 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:

$$\hat{\delta}_{sm} = \alpha + \gamma \, Dec_m + X_s \, \Theta + Z_m \, \Omega + \zeta_{sm} \qquad \text{(Eq.4)}$$

Where $\hat{\delta}_{sm}$ is the effect of chain 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-chain across-school variation in both the dependent variable and school controls. However, our variable of interest (Dec_m) is constant within chains – so we cluster standard error at this level. When instead we consider chain average

[22] We also experimented with chain-level clustering and reached very similar conclusions.

[23] Note that our school-specific effectiveness analysis uses ITT estimates – not instrumental-variable (IV) ones. Using an IV approach would require estimating nearly 2,000 first-stage regressions, which would be impractical. We return to this point below where we present our findings.

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

effectiveness or the standard deviation of chain effects across-schools, our data is at the chain level, so we only apply robust standard errors.

Before moving on, we emphasise that we see this analysis as a way to provide evidence that our assumption that chain's structures are driven by decisions aimed at maximising value-added (i.e., 'output') is borne out by the data: if chains choose their organization in ways that maximize learning, then the equilibrium relationship between chains' average performance and organizational set-up should be flat. Anticipating our findings, we find that this is the case. [25]

5. The determinants of decentralisation

5.1 Descriptive statistics

Descriptive statistics for the key variables we use in our analysis of the determinants of decentralisation are presented in Table 1. Starting from the top, we find that the mean for our main decentralisation proxy is 0.55 – although some chains decentralise none of their decision making (proxy = 0) and other delegate all of the domains we cover (proxy = 1).[26] We also find that the average chain 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 chains only include schools *at* the frontier (distance = 0). Finally, we find that a Herfindahl index of geographic concentration of chains (calculated using the shares of schools each chain operates in different LAs) has a mean value of 0.8 and covers the range 0.05 to 1 – suggesting most chains are very clustered, while 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 chains 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 chains have congruent preferences. Due to missing data on qualifications in the SWF, the average share of schools within chains for which we were unable to reconstruct the background of the local management

[25] Our test assumes that the proxies we use to capture information diffusion on best practices and alignment of preferences are unbiased measures of the 'true' variables that chains use to measure the gains and losses from delegation. This, however, might not be the case. For example, one could imagine instances where the quality of information a chain has affects both performance and its decision to decentralise. In this instance, we would find a negative relationship between performance and delegation because chains with worse information endowments decentralise and perform poorly. Empirically, we find that this is not the case.

[26] 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.

team is 17%. In some checks, we provide evidence that our results are unaffected if we focus on chains with no missing data. The table also shows that the percentage of chains 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 chains 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, more than 60% of those that were education-focussed in 2009 retain the same ethos in 2015. These correlations remain strong even after controlling for chain basic characteristics – such as number of schools, age and geographical spread. Conversely, our proxy for school / chain preference alignment changes substantially: the correlation between 2009 and 2015 is around 0.27 – irrespective of whether we control for school and chain characteristics. Such low correlation comes from changes in the share of school managers who have a private-sector 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 chain itself has a private sector orientation – with associations of around 0.03-0.07 depending on whether we control for chain characteristics.[27]

We also provide some descriptive evidence on how a business orientation is correlated to school resources. Our evidence is presented in Online Appendix Table 4. 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, 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 resources spent on learning (Column 5) and back-office

[27] 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.

activities (Column 7), most likely funded by using the school facilities (and other services it provides) to generate extra resources (Column 9).[28] The bottom panel focuses on chains by summing up school funds and revenues at the chain level. As discussed, chains are mostly funded by top-slicing school resources – and no consistent data exist on how chains 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). 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.[29] As predicted by the organizational economics of firms, we find that chains that include schools that are on average further away from the technological frontier are less likely to decentralise decision making. We also find that age is non-linearly linked to a chain's decision to decentralise decision-making. This is similar to the findings in Acemoglu et al. (2007). Conversely, 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 chain board expertise – is a significant predictor of decentralisation.

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 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, though the patterns 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

[28] 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.
[29] All columns include a control for the incidence of missing information on school/chain preference alignment.

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 have, 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).[30] This does not meaningfully alter our conclusions.[31] Finally, Column (6) we split once again the distance to frontier proxy into its two underlying components – and find patterns comparable to those of Column (2).

Importantly, across all columns we control for a dummy identifying chains 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 chain board that determines decentralisation – rather its alignment with the background of the local management team.

To 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 and other members of the local management team and board members to a business or education background.[32] 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 meaningful information – and not just noise.[33]

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

[31] We checked whether weighing chain averages by school size affect our results. We find this is not the case. Considering the two information diffusion proxies, the coefficient on distance to frontier obtained when weighing averages by school size is -0.2499 (significant), while the coefficient on heterogeneity is 0.2255 (not significant). Note that the age indicators are based on the date in which the first school joined the chain, and school-chain board alignment is defined as an indicator for chains where the majority of schools is aligned. Therefore, we do not re-reweight these two variables.

[32] 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).

[33] We also checked whether our results change if we treat 'arts' and 'foreign languages' as giving members of the school management team a mixed background. This approach yields a 0.114 estimate, significant at the 1% level.

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 chain board expertise are approximately 22% more likely to decentralise. In short, our results capture meaningful economic effects.

5.3 Dealing with endogeneity concerns

As discussed, one concern with a casual interpretation of our results is the possibility that schools select to join a specific chain because they have attributes that make them more compatible with the group structure. To deal with this possibility, we replicate our main result for schools in areas in which chains held a dominant position. In such 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 chains to be more / less centralised.

We present our evidence in Table 3. Column (1) reports our favourite specification – 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 chain. Each school joining a chain 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 at the time when it joined. Adding such control does not affect our findings.

In Columns (3), we only consider chains 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 chains 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 chains (instead of chains) if the LA concentration measure in the year in which they joined was below the median of the concentration distribution at that time. This restriction in turn drops 144 chains

with only schools that joined in competitive environments – leaving us with 247 chains and the 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 our findings.

5.4 Further checks and results

Table 4 presents a number of additional checks on our favourite specification (Column 5 of Table 2). 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 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 instead of value-added. We found that this enters our specification with a small, insignificant coefficient (-0.048; s.e. 0.176), suggesting that in our context value-added is a better proxy for the elements of school productivity that matter for chain decentralisation.

Next, we test the robustness of our definition of technological heterogeneity. These checks are important as we find no association between heterogeneity and decentralisation – which runs counter 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 also does not affect our findings. In some additional checks (not tabulated for space reasons), we constructed our proxies for the heterogeneity 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 chains 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 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 chain board. This approach yields a significant and sizeable association between preference congruence and decentralisation: a one standard deviation increase in our proxy increases 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 magnitudes. A one standard deviation increase in the distance to the frontier increases decentralisation by 14% of a one standard deviation; chains 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. We still find no association between decentralisation and heterogeneity.

In other un-reported results, we tested the robustness of our findings along other directions. First, we replaced the chain-age dummies with either a variable counting chains' age in months or this variable and its square. This approach did not alter our main conclusions. Second, we used information on funding structures of chains to control for whether they 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 measure decentralisation. These changes did not affect our results.

We also investigated the relationship between our key proxies and decentralisation item-by-item. Our findings are tabulated in Online Appendix Table 5. We find that distance-to-frontier is more 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 always correctly signed and point in the right direction across all the domains. Although there is some heterogeneity across the columns presented in the table, we avoid drawing firm conclusions as to which items are more affected by our proxies as our data is 'too thin'.

Lastly, we looked at the association between decentralisation and other variables that have been flagged by the literature on the organisation of firms – but failed to find any clear patterns. For example, we found no evidence that geographical spread and chain size (in terms of number of schools or pupils) are significantly associated with decentralisation.

6. The association between decentralisation and chains' effectiveness

6.1. Estimates of the effect of chains on school attainments

We start this section by discussing our estimates of the effect of joining a chain on students' value-added. 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 (detailed in Section 4.2).

Results that pool across all schools and chains in the sample (estimated using Equation 2) are presented in Online Appendix Table 6. 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 (chain-level clustering did not change the significance of our results). 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 (FSM) 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 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 or LA-by-year (non-parametric) effects. This does not significantly affect our results.

We carried out a number of checks on our results. First, we examined whether the parallel-trend assumption required by our DiD approach hold in our sample. Our evidence in presented graphically in Online 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 Online Appendix Table 6. Panel A uses the stacked-by-event design described above; Panel B implements the estimator proposed by Sun and Abraham (2021). 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 chain 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; all years before Year -7 have been grouped together. Our evidence shows that there were no trends in attainments before schools joined their chains. However, we see a small performance up-tick in Year 0, which could be due to the fact that some schools join a chain 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 chains. In practice, the latter does not seem to be a significant issue in our data. Online Appendix Table 7 shows that the number of schools that join a chain 'off-diagonal'– i.e., not at the time of conversion – is small. Nonetheless, Column (6) of Online Appendix Table 6 shows 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). This approach yields a smaller effect – consistent with the idea that most of the estimated impact stems from being part of a chain. We also estimate 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 find 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.[34]

Lastly, in Column (7) we present our IV strategy where we predict attendance at a school in a chain 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

[34] This is consistent with Neri and Pasini (2023) who show that most of the benefits of primary school conversion to academy are concentrated amongst those that join a chain.

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.[35]

6.2. School- and chain-specific effectiveness

In this section, we discuss our school- and chain-specific effectiveness estimates. These come from specifications identical to those of Column (3) of Online Appendix Table 6, where we allow each school to have its own specific estimated effect (see Equation 3, Section 4.2). Our findings are presented in Online 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 chain-averaged effects; and finally, the bottom-right panel depicts the standard deviation of school-specific effects within chains.

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 25th/75th percentiles of the school-specific estimate distribution are -0.067/0.218, respectively. The top-right shows that many of these estimates are highly significant. The median/mean t-stats are 13.77/16.27, with top and bottom 25th percentiles of the distribution at 43.40 and -13.35, respectively. The bottom-left panel presents chain-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, the bottom panel reveals a significant amount of within-chain, across-school variation in effectiveness. While the least dispersed chains 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 equilibrium association between decentralisation and effectiveness

In this section, we relate the variation in chain effectiveness presented in Online Appendix Figure 4 to our measures of chain decentralisation.[36] We start presenting our findings

[35] 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 chain 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).

[36] As discussed, we use reduced-form (rather IV) estimates in our analysis. 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

graphically in Figure 4, which depicts scatterplots of the association between decentralisation and: *i*- school-specific estimates (Panel A); *ii*- chain-averaged estimates (Panel B); and *iii*- within-chain, standard-deviation of school-specific effectiveness (Panel C). We use the continuous, standardised proxy for decentralisation used in Table 4, Column 9 – as scatter plots of effectiveness against a binary proxy are not very informative. We consider our dichotomous indicator later when we discuss our regression findings.

Overall, we find little evidence of any strong association 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 – although again this is 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 focus on chain-average effectiveness and the standard-deviation of effectiveness within-chains. Regressions are at the chain-level. 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 included as chain 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 chain-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-chains, across schools – and a positive but small relationship when considering the dichotomous organizational variable.

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next are not biased by potentially different school-specific first-stages (i.e., differential pupil mobility after legacy assignment) in more/less decentralised chains. Results are available from the authors upon request.

As discussed, we view the evidence as a test of our maintained assumption that chains choose their organizational form to maximise output – namely, students' learning. The lack of strong associations between decentralisation and effectiveness backs this intuition: the equilibrium relationship between performance and organizational set-up should indeed be flat.

6.4. Equilibrium relationship or lack of association?

We have interpreted the lack of association between decentralisation and performance as evidence that chains choose structures that maximise output. However, such relationship could instead betray a lack of impact of a chain's organization on school performance. To dispel this alternative, we conclude our analysis by investigating whether the association between school performance and decentralisation is flat for all schools within the chain. Specifically, we focus on schools that are likely 'mismatched' to their chain and for which chain-wide decentralisation decisions might not be conducive to high levels of productivity (i.e., students' learning).

To characterise schools that are matched or mismatched, we consider several domains. First, we look at whether a school is a 'sponsored' academy (i.e., an underperforming school that becomes an academy out of necessity) or a 'converter' academy (i.e., a strong school that becomes an academy to acquire more operational freedom) and belongs to a chain in which most schools are of the same or a different academy type. We believe this dichotomy neatly captures the potential tensions between what is good for the chain overall – but might or might not be good for a school given its institutional type. Secondly, we look at the composition of students in terms of FSM eligibility (a proxy for children living in low-income families) and White ethnic background (normally associated with more affluent backgrounds). Using these variables, we characterise schools that have more 'difficult-to-teach' students than the median school within the chain. Once again, these are schools that potentially lose out from decisions taken by the chain to maximise average learning. Finally, we look at two measures that relate to productivity. The first one is school value-added; the second one is each school's distance from the technological (value-added) frontier in the LA in which it operates. The latter proxy (which we use in our main analysis of the determinants of decentralisation) is meant to capture whether the school is 'innovative' or a 'laggard'. Once again, using these proxies we identify schools that lie below (for value-added) or above (for distance to the frontier) the median school in that chain – so that we identify schools for which decentralisation might not be beneficial (despite being optimal at the chain level).

Our evidence is presented in Figure 5. The different plots report 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. All specifications include school, chain and market-level controls. For convenience, the top row reproduces our baseline estimates.

The left panel considers all schools within the chains – and the regressions in this sample strongly support our conjectures. For schools that are weaker and mis-matched to their chain in terms of academy type, students' demographics and productivity, the relationship between decentralisation and performance is negative and significant. For all other schools (i.e., those where the school-chain match is good), this association is flat or slightly positive (but not significant).[37]

While these results are indicative, they are potentially affected by biases. In particular, schools could choose to join chains (or chains could choose to take on schools) with a good match-specific component. To alleviate this concern, in the central panel of Figure 5 we replicate our analysis for the subset of schools that join chains under monopolistic conditions (see Section 5.3). The patterns we find in this panel resemble those we see for the full sample – especially for the dichotomies based on academy types, pupils' FSM eligibility and value-added measures. However, our findings are noisier, which is to be expected given the small samples. The set of schools joining under monopolistic conditions includes 599 schools out of the 1,196 in the full sample, implying that some of the subgroups contain less than 260 schools.

Finally, we provide additional evidence by devising an instrumental variable strategy to by-pass the possible match-specific bias mentioned above. Specifically, we instrument the decentralisation measure faced by school *i* in chain *m* at time *t* with the decentralisation measure of school *j* identified as follows: 1- school *j* is the closest school *i* has in the same LA; and b- school *j* joined a chain before the time *t* when school *i* joined its chain.[38] The intuition for this instrument is that schools might join chains depending on what 'they know about them' through the local networks of other schools having made the transition before them – irrespective of match-specific gains. This is the variation we are trying to capture with our instrument.

This instrument is a strong predictor of a school's specific decentralisation. Considering all schools in the sample, the F-test associated with the first stage is 98.74. The instrumented estimate for the full sample reported in the first row of the right panel confirms that there is no

[37] We investigated whether these patterns are driven by specific items that chains decide to decentralise (see discussion in Section 5.4 and Online Appendix Table 5). Although the patterns we found were not very conclusive, the heterogeneity between mismatched and well-matched schools was mostly evident for the decentralisation of assessment, curriculum, professional development, and teaching equipment procurement decisions.

[38] We tried variants of this instrument – e.g., by imposing that school *i* and school *j* are of the same academy type (sponsored/converter) or phase (primary/secondary). These returned very similar results.

association between decentralisation and school performance on average within the chain. When it comes to our school partitioning, we find that once again most of the patterns presented in the first panel are similar to those obtained with this strategy – although the estimates are imprecise.[39] Once again, this is not surprising. Although all group-specific first stages are strong (the smallest F-test we have is 30.61), we do not have enough schools in the sample to significantly estimate these patterns of heterogeneity (especially considering that 2SLS return larger standard errors for the instrumented/endogenous variables than OLS).

While we acknowledge their limitations, we also highlight that the patterns uncovered using these three different approaches are very consistent. We take this evidence to suggest that the flat relationship between decentralisation and performance is not symptomatic of the fact that organisational structures don't matter. For schools that do not 'blend in' with the chain, we consistently observe negative effects from more decentralised structures – albeit not always significant ones. This aligns with the view that the overall flat relationship stems from the fact that chains are optimally choosing their structures on average. However, while beneficial for the chain overall, this can create within-chain distributional issues – by producing schools that 'win' and 'lose out' from more decentralised decision making.

7. Conclusions

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 chains 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

[39] Expanding our sample of analysis is not feasible because: *i*- we do not have access to more recent pupil-level data to estimate school effectiveness; and *ii*- even if we did, our measure of decentralisation is only available for the subset of schools that were in chains in 2016 – so we would not be able to significantly increase sample size.

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. 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 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 chains in several institutional contexts – such as the US, the UK, Sweden and Chile – that pioneered autonomy in education, but are seeing more of their schools being bound together within organizations with varying degrees of centralisation of decision-making.

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. (2021) 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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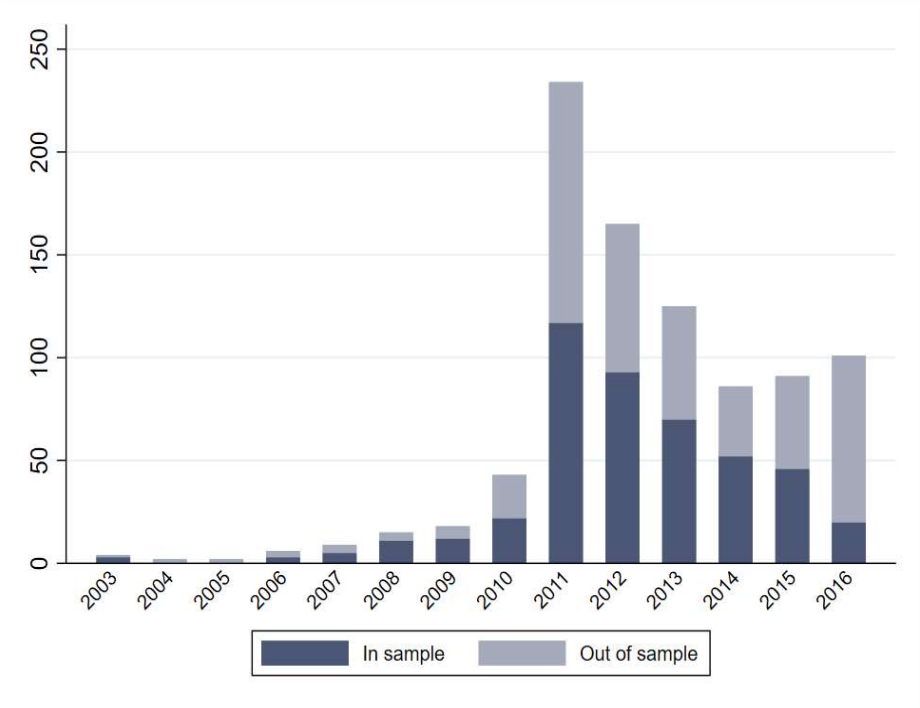
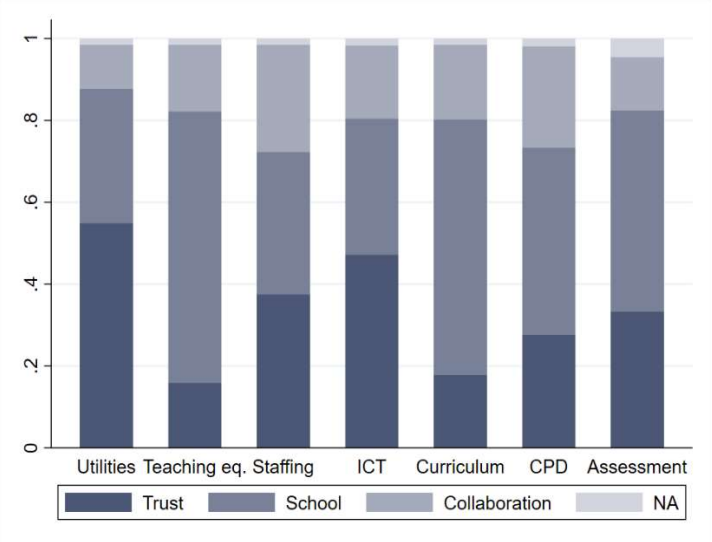
Figures and Tables

Figure 1. Number of chains opening by year



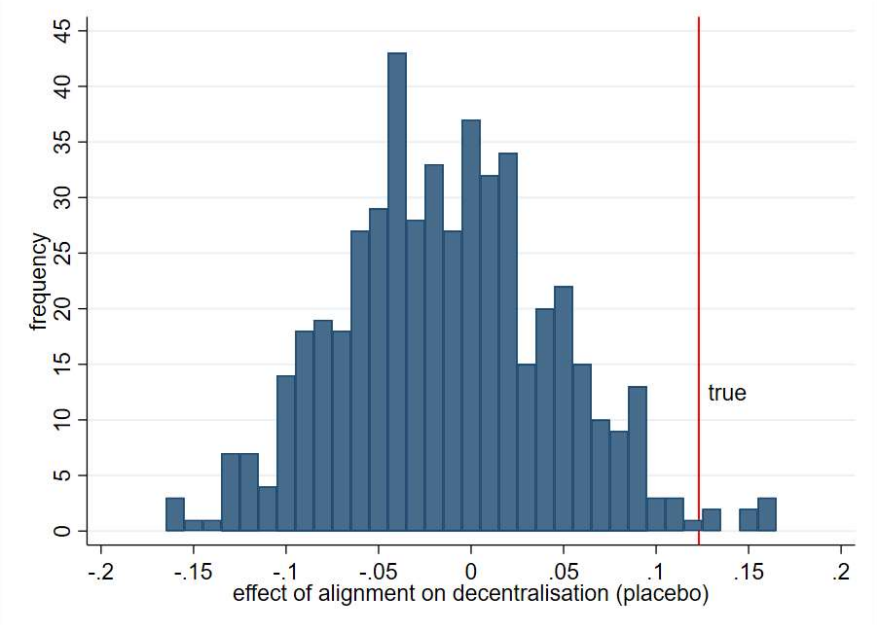
Notes: numbers are based on the academic year in which the first school of the chain joins the organization. No chain existed before the academic year 2002/2003.

Figure 2. Procurement and distribution of roles within chains - by surveyed items



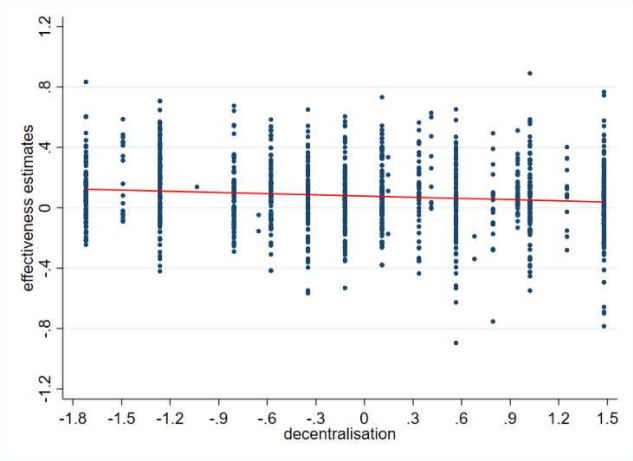
Notes: data available from the BESA survey of chains. The exact number of observations varies depending on the specific item. Information on procurement and decentralisation of facilities maintenance is not tabulated (or used in the main analysis) due to a large number of missing observations.

Figure 3. Distribution of Placebo Estimates for School – Chain Board Alignment

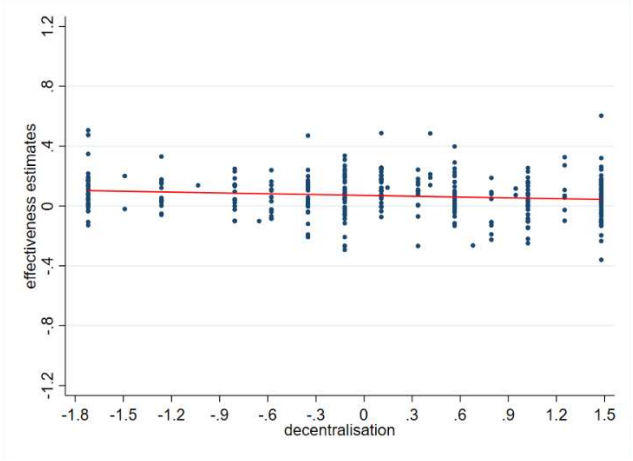


Notes: the figure reports the distribution of the estimates of the placebo school – chain board alignment obtained by replicating 500 times the procedure outlined in Section 5.2. The estimates were obtained using the specification in Column (5) of Table 2. The mean and median values of the distribution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

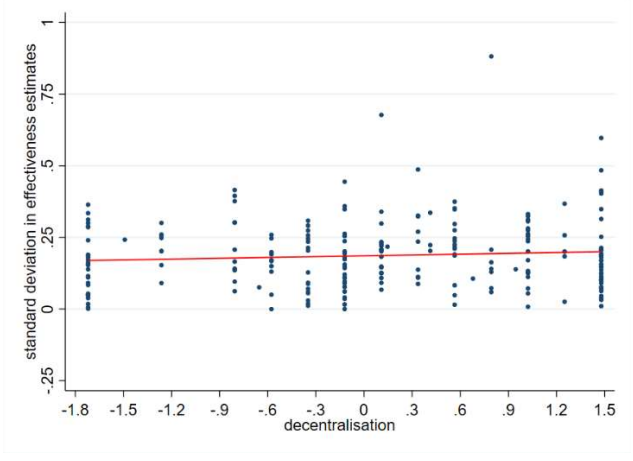
Figure 4. Effectiveness and decentralisation



Panel A. Schools



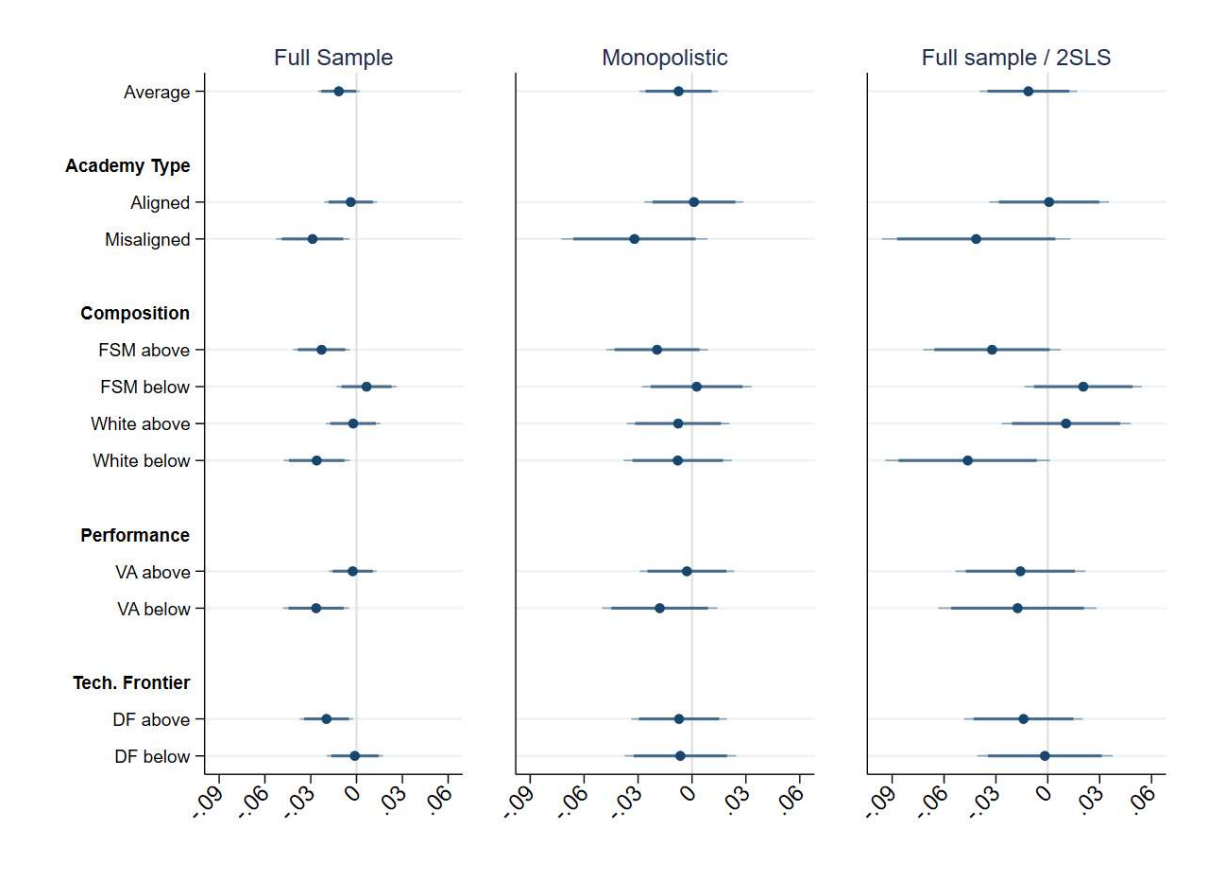
Panel B. Chains



Panel C. Standard deviation of effectiveness

Notes: the figure shows scatterplots of school- and chain-specific effectiveness estimates (Panel A and B respectively) and within-chain 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 Chain 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 left-side panel considers all schools within the chain; the central panel only considers schools that joined a chain under monopolistic conditions (see discussions in Section 5.3); the right-side panel consider all school but instruments decentralisation. The median for the variables listed on the vertical axis is computed within-chain and using all schools. This approach captures the relative position of the school within the chain. All specifications include school, chain controls and market-level controls. The top rows reproduce our baseline (average) estimates (Table 5, Columns 3).

Table 1. Descriptive Statistics

	Mean	SD	Min	Max
	(1)	(2)	(3)	(4)
Chain 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
Chains 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 chain board alignment (2009)	0.3397	0.3543	0	1
Majority of schools aligned with chain 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 chain; 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 chain 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 chain. 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 chain. 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 chain. School and chain board alignment based on the educational background of the headteacher and the school managerial team compared to the specialism of the board of the chain (business/economic vs. educationalist vs. mixed). A chain is defined as having the majority of schools aligned if more than 50% of schools belonging to the chain are aligned with the chain board. Board alignment missing represnts the share of schools within chains for which we could not reconstruct the background of the school managerial team. Herfindahl index based on the shares of schools in the chain 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 - chain 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
Chain 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 chain for which the board alignment information could not be reconstructed. School chain controls include: average number of months since the school joined the chain (school age, in months); standard deviation of school age within the chain; average number of students in the schools within the chain; standard deviation of the number of school students within the chain; standard deviation of school value-added within the chain; chain size (total number of schools); total number of pupils in the chain; Herfindahl index (share of schools in different LAs); dummy for chains 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. Chains with monopolistic position

	Dependent variable: extent of decentralisation			
			Keep only chains:	
	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 - chain board alignment	0.1231**	0.1229**	0.0808	0.1257*
	(0.0546)	(0.0547)	(0.0868)	(0.0753)
Observations	391	391	195	247
Chain 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 chain for which the board alignment information could not be reconstructed. All other controls as in Table 2. Monopolistic/non-monopolistic markets and chains 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

	Base	Distance to frontier		VA heterogeneity		Alignment measure:			Outcome:
		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 - chain 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
Chain 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 chain 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

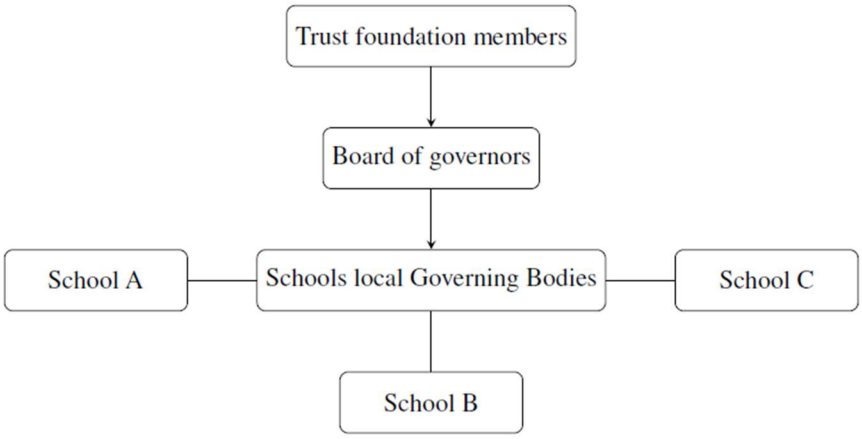
Table 5. Decentralisation and school effectiveness

	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 chain						
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-chain 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

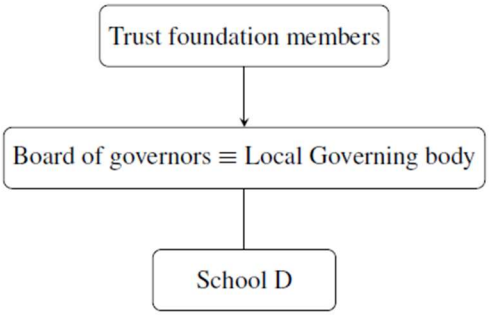
Notes: The Table shows OLS regressions of estimates of effectiveness at school level (Panel A) and chain level (Panel B) and within-chain dispersion in effectiveness (Panel C) on two measues of decentralisation. Columns (1)-(3) use a continuous measure of decentralision as defined in the main text; columns (4)-(6) use a dichotomous indicator for chains 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 chain 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 chain controls: average and standardised age, number of schools in the chain, number of students in the chain, herfindahl index, an indicator for chains 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 chain-level regressions of Panel B and C (Columns 1 and 4). They are averaged and included as chain-level controls in the other columns of the two panels. In Panel A, standard errors are clustered at chain level. In Panel B and C, standard errors are robust. *** p<0.01, ** p<0.05, * p<0.1

Online Appendix: Figures and Tables

Online Appendix Figure 1.
Governance structure in MATs (chains) and SATs (stand-alone trusts)



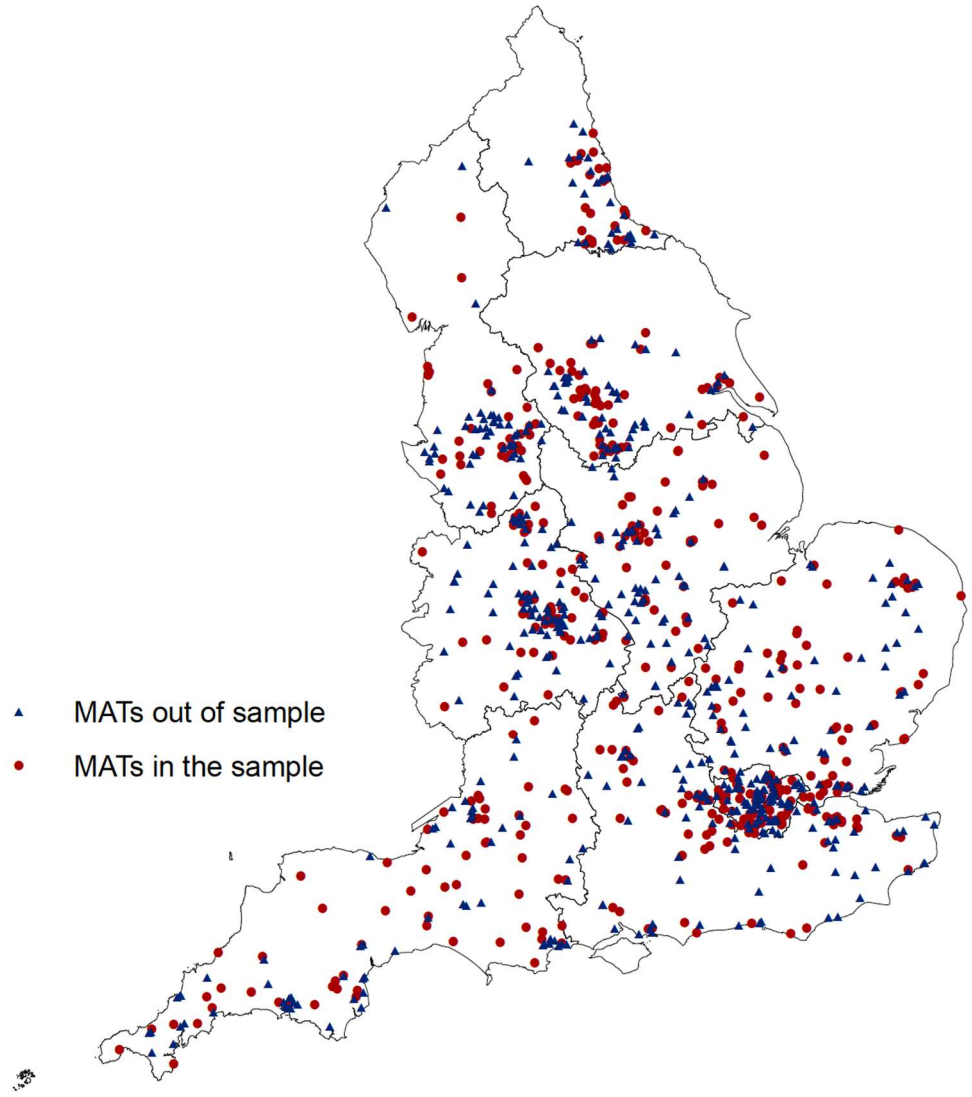
Panel A. Multi-Academy Trusts (MATs)



Panel B. Single Academy Trusts (SATs)

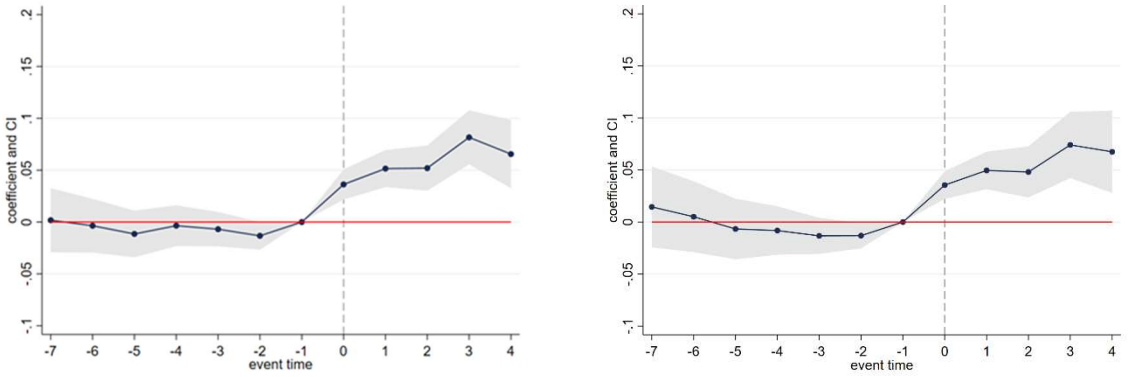
Notes: The figure shows the governance structure in Multi-Academy Trusts (MATs or chains; Panel A) and Single Academy Trusts (SATs; Panel B).

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



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

Online Appendix Figure 3. Event Study

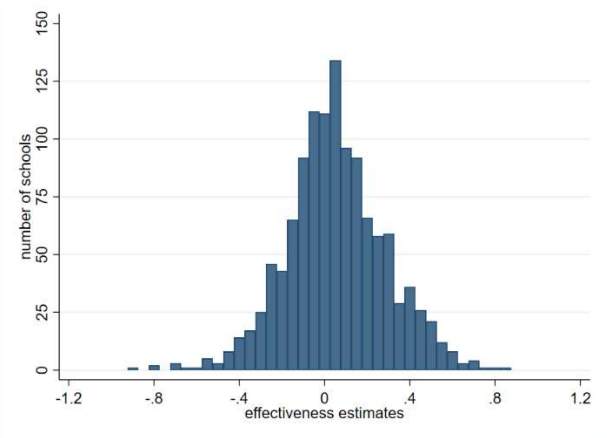


Panel A. Stacked-by-event design

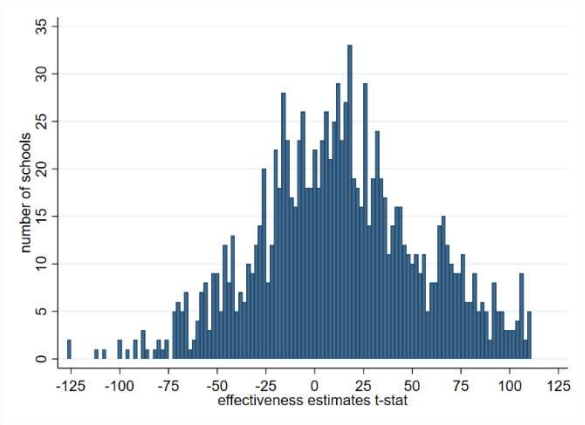
Panel B. Sun and Abraham (2021)

Notes: the figures show time-specific estimates from a regression of student attainment on an indicator variable for being enrolled in a school belonging to a chain 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 Online Appendix Table 6. Other specifications yield similar results and are available upon request. Panel A uses a stacked-by-event design – see main text for details. Panel B implements the estimator by Sun and Abraham (2021). Shaded area indicated 95% confidence intervals. Standard errors are clustered on schools.

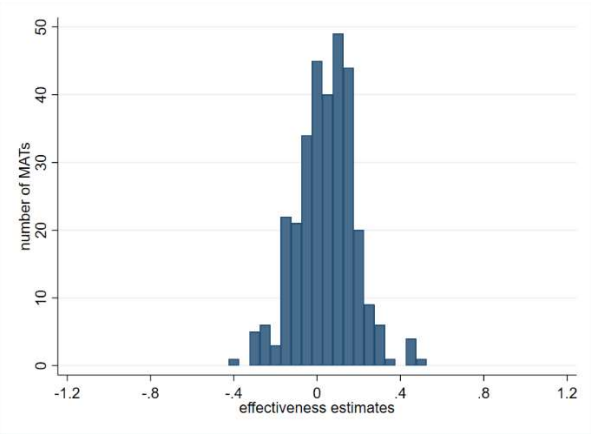
Online Appendix Figure 4. Distributions of effectiveness estimates and effectiveness dispersion



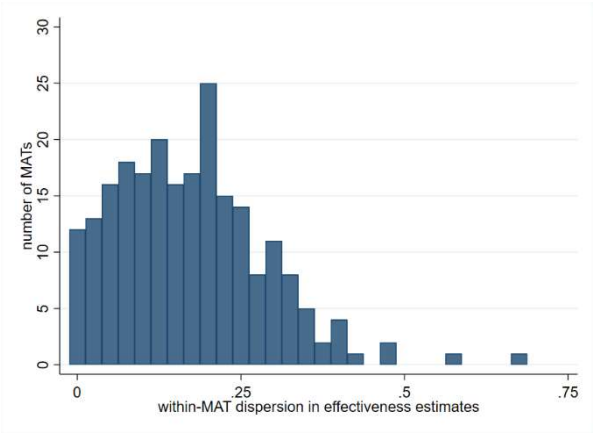
Panel A. School-specific effectiveness



Panel B. School-specific effectiveness t-stats



Panel C. chain-specific effectiveness



Panel D. Within-chain dispersion in effectiveness

Notes: the figure shows the distribution of school-specific effectiveness estimates and their T-statistics (Panel A and B, respectively); chain-averaged school effectiveness estimates (Panel C); and within-chain dispersion in school effectiveness estimates (Panel D). The estimates were obtained using the same specification as in Column (3), Online Appendix Table 6.

Online Appendix: Tables

Online Appendix Table 1.
Comparison between chains included and excluded from the final sample

	Mean (in sample)	Mean (out of sample)	Difference
	(1)	(2)	(3)
Size (number of schools in chain)	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

Online Appendix Table 2. Comparison between chains included and excluded in the effectiveness estimation sample

	Mean (in sample)	Mean (out of sample)	Difference
	(1)	(2)	(3)
Size (number of schools in chain)	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

Online Appendix Table 3.
Comparison between stand-alone academies and schools in chains

	Mean in 2009		Raw difference	Conditional difference
	Stand-alone	Chain		
	(1)	(2)	(3)	(4)
Number of students	386.0172	516.9147	130.8975***	19.4641***
			(11.8837)	(6.1211)
Percentage of FSM students	0.1355	0.1459	0.0104**	0.0058
			(0.0041)	(0.0040)
Percentage of White students	0.8346	0.8338	-0.0007	0.0113*
			(0.0067)	(0.0067)
Percentage of SEN students	0.1985	0.2143	0.0158***	0.0095***
			(0.0032)	(0.0032)
Percentage of English-native speakers	0.881	0.886	0.0050	0.0087
			(0.0054)	(0.0056)
Percentage of males	0.5087	0.5088	0.0002	0.0002
			(0.0033)	(0.0035)
Value added, measured in 2009	-0.0275	-0.002	0.0255***	0.0170*
			(0.0096)	(0.0100)

Notes. See Table 1 for variable descriptions. Column (3) presents raw differences, while column (4) adds school phase (primary/secondary) and academy type (converter/sponsor led) dummies. The number of schools is 5,902 except for VA that are 5,359. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Online Appendix Table 4.
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. Chains									
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 chain-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-chain correlation in Panel A and for heteroskedasticity in Panel B. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix Table 5.
Decentralisation Decisions for Single Procurement Items

	Base	Extent of decentralisation in:						
		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 - chain 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
Chain 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 chain 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

Online Appendix Table 6.
The Impact of Joining a Chain on Student Performance

	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.

Notes: The table shows estimates from regressions of student attainments on an indicator variable for being enrolled in a school belonging to a chain. The 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 chain. Appendix Table 4 presents a cross-tabulation of the two dates. Column (7) instruments enrolment into chain schools at the time of the test with an indicator for being 'legacy' enrolled in a chain school. More details are provided in the main text. Standard errors are clustered on schools. *** p<0.01, ** p<0.05, * p<0.1

Online Appendix Table 7.
Year of Conversion vs Year in which Schools Join a Chain

	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 chain ('join year').

Online Appendix Lookup Table 1: Mapping between occupations and groupings

Link

Online Appendix Lookup Table 2: Mapping between degree types and groupings

Link

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Recent Discussion Papers

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1990	Michael Ball Paul Cheshire Christian A.L. Hilber Xiaolun Yu	Why delay? Understanding the construction lag, aka the build out rate
1989	Gianmarco I.P. Ottaviano Davide Suverato	Fantastic beasts and where to find them
1988	Kohei Takeda Atushi Yamagishi	The economic dynamics of city structure: Evidence from Hiroshima's recovery
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1985	Tom Kirchmaier Ekaterina Oparina	Under pressure: Victim withdrawal and police officer workload
1984	Melanie Arntz Sebastian Findeisen Stephan Maurer Oliver Schlenker	Are we yet sick of new technologies? The unequal health effects of digitalization
1983	Javad Shamsi	Immigration and political realignment

1982	Ekaterina Oparina Christian Krekel Sorawoot Srisuma	Talking therapy: Impacts of a nationwide mental health service in England
1981	Xiao Chen Hanwei Huang Jiandong Ju Ruoyan Sun Jialiang Zhang	Endogenous mobility in pandemics: Theory and evidence from the United States
1980	Alan Manning Graham Mazeine	Should I stay or should I go? Return migration from the United States
1979	Rosa Sanchis-Guarner José Montalbán Felix Weinhardt	Home broadband and human capital formation
1978	Luca Macedoni John Morrow Vladimir Tyazhelnikov	Firms in product space: Adoption, growth and competition
1977	Gonzalo Nunez-Chaim Henry G. Overman Capucine Riom	Does subsidising business advice improve firm performance? Evidence from a large RCT
1976	Julian Alves Bruno Serra Jason Greenberg Yaxin Guo Ravija Harjai John Van Reenen	Labour market power: New evidence on Non-Compete Agreements and the effects of M&A in the UK
1975	Virginia Minni	Global managers, local workers: Wage setting inside a multinational firm
1974	Jonathan Colmer Suvy Qin John Voorheis Reed Walker	The changing nature of pollution, income and environmental inequality in the United States