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Abstract

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Keywords: university spinout, equity allocation, fundraising

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Abstract. Universities generate breakthrough commercial technology, yet controversy persists regarding the optimal ownership stake they should retain in spin-outs commercializing these discoveries. This paper examines if higher university stakes inhibit spin-outs from raising venture capital funding. The analysis is based on a formal theory of spin-out fundraising, and draws on detailed administrative ownership data from spin-outs in the United Kingdom. Using an instrumental variable based on precedents set by prior spin-outs within a university, we find evidence that university stakes are a barrier to academic entrepreneurship, consistent with weakened founder incentives to raise venture capital. This effect is concentrated in universities that historically had higher university stakes.

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1. Introduction

"Oxford's equity demands severely constrained my entrepreneurial ambitions, why would I surrender half of my venture at its inception?" observed Nando de Freitas.[1] In 2014, he founded Dark Blue Labs to commercialize his pioneering neural network research. Oxford's equity stipulations, however, posed constraints that de Freitas was unwilling to meet. Instead, he abandoned his entrepreneurial aspirations, resigned his professorship, and joined DeepMind. His experience is not an isolated anecdote but emblematic of a broader tension in academic entrepreneurship that has been widely debated among university leaders (Tracey and Williamson 2023).[2] University stakes, designed to capture value created within the university, can inadvertently impede entrepreneurial value creation. The central question follows: How much ownership can universities claim before they begin to stifle the very entrepreneurship they seek to foster?

This tension reflects a classic problem in strategy research: balancing value creation and value capture (Lepak et al. 2007). In most entrepreneurial contexts, the two are aligned, since the same actors both generate and appropriate value. University spin-outs, however, introduce a structural misaligned: universities retain ownership of the IP arising from faculty inventions, while faculty provide the entrepreneurial effort (Jensen and Thursby 2001). As a result, academic entrepreneurs must license their own technologies, commonly in exchange for equity (Feldman et al. 2002). This misalignment is further intensified by *contingent value capture*: universities claim larger stakes in ventures they deem most promising, even though such claims can weaken founders' incentives to exert entrepreneurial effort (Hellmann 2006). Consequently, high-potential spin-outs may bear disproportionate burdens, undermining the diffusion of breakthrough commercial technologies (Colyvas et al. 2002).

[1] Personal communication with Nando de Freitas. See also The Telegraph article, "University tech spinouts: Oxford is the worst university in the world for commercialisation" (2017).
[2] See also practitioner arguments against university stakes in spin-outs in Air Street Capital (2021) and Sifted (2022).

Broadly speaking, the thinking about equity allocation is shaped by two competing logics. The university-friendly view holds that universities deserve a reasonable equity share reflecting their institutional contributions (Di Gregorio and Shane 2003, Saava and Taneri 2015). In contrast, the founder-friendly view maintains that equity should be allocated chiefly to motivate founders to exert entrepreneurial effort (Kenney and Patton 2009, Litan et al. 2007). These competing logics, which mirror deeper institutional tensions in the rise of the entrepreneurial university, often fuel disputes between universities and their faculty (Merton 1973, Etzkowitz 1998). Our study contributes systematic evidence to this debate by empirically assessing whether, and to what extent, higher university stakes diminish spin-outs' commercial prospects.

The United Kingdom offers a salient setting to study university spin-outs. It is widely recognized as a global leader in creating valuable IP and nurturing high-technology ventures. The UK also has mature financial markets and it has publicly available company registries maintained by Companies House. This registry records shareholder identities and exact equity stakes, providing unusually granular data that allows us to measure with precision the equity allocations universities receive when their IP is commercialized through spin-outs.

How should university equity claims balance the creation of spin-out value with the capture of institutional returns? To formalize this trade-off and anchor our empirical analysis, we develop a theoretical model grounded in the incomplete contracts literature of Aghion and Tirole (1994) and Jensen and Thursby (2001) first applied this framework to technology transfer. Our model highlights two opposing dynamics: an *incentive effect*, whereby higher ownership claims reduce founders' marginal returns from effort, weakening their motivation to create value through commercialization; and a *selection effect*, whereby universities demand larger university stakes precisely when a spin-out appears more promising, linking institutional value capture to stronger underlying commercial potential. By embedding both value-creation and value-capture logics, our model also explains the endogeneity we confront in the empirical analysis.

Our indicator of entrepreneurial success is raising venture capital (VC), which is widely considered a strong signal of commercial progress (Gompers and Lerner 2001). Yet our initial regressions yield a pattern consistent with the selection effect: even after accounting for standard observables (technology class, location, university, founder team characteristics, and calendar year), we find small, positive but statistically insignificant correlations between university stakes and the likelihood of raising VC funding. Recognizing that correlation does not imply causation, we use an instrumental variable (IV) strategy to disentangle selection from incentive effects.

Our identification strategy leverages institutional inertia: past equity deals shape the terms of present negotiations. Universities do not bargain in a vacuum; their positions are anchored in the stakes they secured in comparable spin-outs in the recent past. Our IV estimates reveal a clear, economically meaningful pattern. The first stage of the IV confirms that precedent stakes strongly predict the equity allocations of subsequent spin-outs, establishing the instrument relevance. In the second stage of the IV, the instrumented coefficient of the university stake is negative and statistically significant: university equity substantially reduces the likelihood of VC funding. We conduct robustness checks using alternative IVs that also permit overidentification tests, and using saturated university-by-year fixed effects that further account for dynamic institutional effects.

When do university stakes most effectively stifle spin-out fundraising? Our framework predicts that modest equity claims may leave founder incentives largely intact, but that once university stakes climb higher, their effects become far more damaging. To test this threshold logic, we partition universities by the level of their initial university stakes in the first year we observe them. The evidence points to a clear threshold: below the sample median, additional university claims have little effect on fundraising, but above it, they sharply undermine founders' ability to attract VC. In other words, once universities cross this ownership threshold, their equity demands shift from manageable to prohibitive.

This paper makes four key contributions. First, we advance the literature on value creation and capture in academic entrepreneurship (Jensen and Thursby 2001, Hvide and Jones 2018, Åstebro et al. 2019), by documenting the causal effect of incremental changes in the *level* of value capture on value creation, while holding constant the instrument of value capture (equity in spin-outs) and the ownership of IP (universities vs. researchers). Second, we extend the literature on TTO decision quality (Jensen and Thursby 2001, Mowery et al. 2002, Hsu and Kuhn 2023) by showing that TTOs exhibit a systematic tendency to set university stakes at levels that reduce founders' incentives to raise funding, although we observe a downward trend, reflecting universities' adjustments over time. Third, we contribute to the debate on what motivates scientists to engage in commercialization (Lach and Schankerman 2008, Lam 2011, Cohen et al. 2020), by showing robust evidence that financial incentives play a significant role in the spin-out context. Fourth, we complement the literature on comparative ownership and firm performance (Morck et al. 1988, Shleifer and Vishny 1994) by introducing university ownership as a new ownership category with distinctive features.

The paper is structured as follows. Section 1 lays out the theoretical framework. Section 2 introduces the data and details our university stake measure. Section 3 examines what drives universities to claim more or less equity. Section 4 delivers the central empirical results on how university stakes shape the probability of securing VC funding. Section 5 broadens the lens, tracing implications for academic entrepreneurship and reporting auxiliary results. Section 6 concludes.

2. Theoretical Foundations

We build a parsimonious model of the commercialization process to study how university stakes affect founders' incentives. Rather than capturing every nuance, the model generates clear predictions about how equity allocations influence the balance between value creation and value capture – specifically, how they shape the likelihood of securing VC funding. Our contribution is to extend optimal

contracting theory by explicitly modeling how university stakes shift entrepreneurial incentives in this context. The model builds on the broader theory of optimal contracts. Aghion and Tirole (1994) provide a general account of innovation under incomplete contracting, whereas Jensen and Thursby (2001) and Hellmann (2007) focus more narrowly on incentive structures in technology transfer. Hvide and Jones (2018) develop a model in which both academic founders and universities create value. The unifying insight in this literature is that ownership stakes should accrue to agents whose efforts most strongly influence overall surplus.

The model features two players: a scientist (S), who has made a discovery with commercial potential, and the university (U), which owns the IP and controls spin-out formation.[3] Throughout the analysis, all parties are assumed to be risk neutral, and we abstract from time discounting. Building on the analysis in Teece (1986), spin-outs exemplify a structural misalignment; the agents who generate technological value are not necessarily those who appropriate it. Value creation stems from S' entrepreneurial effort in transforming scientific discoveries into consumer-surplus-generating products, while value capture reflects the allocation of monetary returns between S and U, with U securing a significant portion through contractual mechanisms such as university stakes.

This appropriation rests on the university's ownership of the IP, which functions as its isolating mechanism (Rumelt 1984, Teece 1986). However, the power of this mechanism is limited: excessive university stakes risk losing legitimacy in the entrepreneurial ecosystem (Suchman 1995). Following Tost's (2011) integrative framework, legitimacy judgments combine three dimensions. Instrumental legitimacy is weakened when high university stakes misalign entrepreneurial incentives by reducing founders' expected returns. Relational legitimacy is compromised when university stakes appear unfair compared to peers at other universities. And moral legitimacy is undermined when university policies violate broader norms of fairness in entrepreneurship. Thus, the university's isolating mechanism is

[3] While our empirical analysis will allow for founding teams of more than one founder, for tractability the theory focuses on the case of one scientist and one university.

structurally bounded by legitimacy constraints, which shape both the feasible range of university stakes and the bargaining process.

We formalize this setting in a simple dynamic model with three dates. At date 0, S explores the commercial potential of the discovery while still at the university. Effort is required to transform the scientific discovery into a viable spin-out company (Jensen and Thursby 2001). We denote S's effort by e_q and assume private effort costs are quadratic, i.e., $\frac{1}{2}e_q^2$. With probability q, a new spin-out gets created at date 1. However, with probability $1 - q$, the development process fails, and no spin-out is created. All utilities are normalized to zero in that case. The probability of spin-out creation, q, increases in S's effort e_q. We use a simple linear specification where $q = q_0 + q_1 e_q$. The parameter q_0 measures the success component that is independent of effort (e.g., the strength of the underlying science), and q_1 measures effort efficiency, i.e., it captures how additional effort translates into higher chances of success.

We assume that at date 1, S manages the spin-out and exerts effort to ensure the commercial success of the spin-out. In light of our empirical context, we associate effort with raising VC, but it can also be understood more generally as commercialization effort. We denote S's effort by e_r and assume private costs of $\frac{1}{2}e_r^2$. With probability $(1 - r)$, the spin-out fails and has no value, so that all utilities are zero. However, with probability r, the spin-out raises VC at date 2, achieving a financial value x, which represents the pre-money valuation at the funding round and captures the joint equity value of S and U. Again, we use a linear specification, specifically $r = r_0 + r_1 e_r$. The parameter r_0 measures the success component that is independent of effort (e.g., the strength of the IP), and r_1 measures effort efficiency, i.e., how additional effort translates into higher fundraising probabilities.

The financial value x is divided according to ownership stakes α_S and α_U, where $\alpha_S + \alpha_U = 1$, thus determining the allocation of value capture. The key endogenous variables are the scientist's efforts

e_q and e_r, which in turn creates value by driving the empirically measurable success probabilities q and r. We treat α_U as an exogenous parameter and use its comparative statics to generate our empirical predictions. We present the main theoretical predictions here; full derivations appear in Appendix A. Proposition 1 examines how the probability of a spin-out raising VC depends on the university's equity stake.

Proposition 1: *The probability that a spin-out raises VC, r, decreases with the university stake α_U. Formally, $\frac{dr}{d\alpha_U} < 0$.*

The key intuition is that higher university stakes weaken entrepreneurial incentives, illustrating a form of slippage in value capture: greater appropriation by the university comes at the expense of reduced entrepreneurial effort and a lower likelihood of successful commercialization.

Second, we extend our theory to account for selection effects, which are central to our empirical analysis. Universities may adjust their university stake depending on the venture quality. To capture this, we model negotiations as a reduced-form bargaining game. The university has a default equity policy, taking α_U^*. Enforcing this policy requires incurring a bargaining cost κ, drawn from distribution $\Omega(\kappa)$. Instead of incurring this cost, U can agree to a concession of δ, thereby reducing its stake to $\alpha_U^* - \delta$.

There exists a critical cost threshold κ_1 such that U retains its default stake whenever $\kappa < \kappa_1$ and concedes whenever $\kappa > \kappa_1$. The probability that U retains its default share is therefore $\Omega(\kappa_1)$. Appendix A derives the conditions under which κ_1 increases with the venture's expected success value, x. This leads directly to the following proposition.

Proposition 2: *The probability $\Omega(\kappa_1)$ of the university retaining its default equity share α_U^* increases with the expected success value of the spin-out, x.*

Building on Proportion 2, we define contingent value capture as the systematic dependence of the concession probability $\Omega(\kappa_1)$ on the expected success value of the spin-out, x. Put differently, bargaining outcomes are systematically tied to the venture's expected success value rather than being random departures from policy.

Unlike appropriability regimes or bargaining power, contingent value capture links equity outcomes directly to venture quality rather than institutional or actor-level characteristics. Teece (1986) emphasizes that strong appropriability regimes protect the value capture of innovators; in our context, this logic is inverted. Because universities, not inventors, control IP, stronger appropriability regimes increase universities' capacity to capture value, leaving less to the scientists. Coff (1999) models value capture as the outcome of bargaining among stakeholders with asymmetric leverage. Applied to spin-outs, university control of IP shifts equity toward the institution, whereas founder star qualities can shift it back (Hsu and Kuhn 2022). Together, these perspectives show why one might mistakenly interpret contingent value capture as simply an application of existing theories, while in fact the mechanism is different: equity concessions are systematically contingent on venture quality, introducing an empirical challenge of disentangling treatment from selection effects.[4]

3. Data and Empirical Strategy

The United Kingdom provides a particularly fitting setting. It is a leading source of spin-outs, supported by mature financial markets, and also offers uniquely transparent data on private-firm ownership.[5] The UK Companies Act requires all firms to disclose complete capitalization tables, public records of each shareholder's ownership stake, in annual public filings. This legal requirement allows us

[4] The prediction of Proposition 2 is also consistent with the theory of Debackere and Veugelers. (2005). They argue that universities can signal confidence in their better spin-outs by retaining larger university stakes in them. In Proposition 2 this signal emerges as the equilibrium outcomes of the negotiation process.
[5] According to the tech transfer publication Global University Venturing (2023), UK-based university spin-outs accounted for 26% of all global spin-out funding rounds in 2015 and 2016.

to measure exactly the size of a university's stake in its spin-outs. We provide additional institutional background on the UK in Appendix B.

3.1. Sample of Firms

From the Companies House filings, and following the framework employed by the UK's Higher Education Statistics Agency (HESA 2023), we identify university spin-outs according to a purposive origin criterion: the firm must be established to commercialize IP owned by a UK university. Evidence of this origin is the university's role as a founding shareholder combined with the presence of a university-employed scientist whose research underpins that IP.

We based our initial list of potential spin-outs on Beauhurst, the leading UK startup data provider and a widely used source in prior spin-out research (Hewitt-Dundas 2015, Wright and Fu 2015, Audretsch et al. 2024).[6] Because Beauhurst applies a broader definition, we verified each firm's Companies House filings individually to ensure alignment with our more targeted criteria. This screening process produced a final sample of 649 spin-outs founded between February 7, 2010 and April 23, 2021. Appendix C describes the construction of the sample in detail.

3.2. Shareholder Classification and Equity Types

Companies House records allow us to trace each firm's capitalization tables from inception to the present, beginning with the Certificate of Incorporation and continuing through the annual Confirmation Statements, which document every subsequent change in ownership. Both filings list all shareholders, whom we classify into three groups – university, scientist, and managers – and use to identify each spin-out's founding team, comprising both scientists and managers.[7] For the 2,339 founders in our sample,

[6] Beauhurst differentiates itself from other startup data providers by systematically linking company and funding round information to the administrative records in Companies House. Ulrichsen (2019) likewise notes that Beauhurst offers a more reliable means of identifying the full population of UK spin-out companies than self-reported university surveys. Earlier studies, such as Wright and Fu (2015) and Hewitt-Dundas (2015), relied on Spinouts UK, a dataset subsequently acquired by Beauhurst (2021).

[7] In our analysis, we exclude the investor category – that is, shareholders who are neither universities, scientists, nor managers, and who hold a priced stake in the spin-out.

we hand-collect data on personal characteristics to construct team-level control variables capturing their prior career trajectories. Our primary source for biographical information is LinkedIn, supplemented – particularly for scientist-founders – by their university department webpages. Appendix D details our shareholder-classification methodology.

For each of the three shareholder groups, we record both non-cash equity and priced equity they hold. Priced equity refers to shares acquired through direct financial investment in the company. Non-cash equity denotes ownership stakes granted without payment, and serves different purposes across groups: recognition of universities' IP rights, a retrospective reward for scientists whose discoveries underpin commercialization, and a prospective incentive for managers to guide the spin-out toward market success. The methodology we use to differentiate between non-cash and priced shares is described in Appendix F.

3.3. Spin-Out Timing

Our empirical analysis requires identifying the point at which a research discovery formally transitions into a commercial venture. To this end, we must precisely determine the spin-out date. Although the Certificate of Incorporation may appear to mark this event, it often predates the equity agreement between the university and scientist, sometimes by several months, if incorporation occurs prematurely. In such cases, the capitalization table omits one of the parties and yields a misleading date.

To avoid this error, we define the spin-out date as the date of the first legal filing in Companies House that records an equity distribution between the university and the scientists. Our primary evidence comes from the earliest Confirmation Statement listing both the university and the scientist as shareholders, from which we infer that the spin-out took place within the preceding year. We then refine this estimate using supplementary SH-series share-allotment forms – statutory notices that must be filed within one month of any new share issue (Companies House 2021).[8] Taken together, these filings allow us to identify a precise spin-out date. Appendix E details the methodology to determine the spin-out date.

[8] If multiple share-allotment filings with different filing dates exist in the preceding year, we use the midpoint of the earliest and latest candidate date.

3.4. Variable Construction

We next discuss the variables that we use in our empirical analysis. Table 1 provides an overview of the variables used in our analysis, along with their definitions and data sources. Table 2 provides the corresponding descriptive statistics. Appendix Table J.1 reports the pairwise correlations among the variables of interest.

Insert Table 1 & Table 2 about here

We focus on a firm's ability to attract VC funding as our dependent variable, since it is a key determinant of entrepreneurial success in university spin-outs (Wright et al. 2006). Prior work on spin-out performance has typically emphasized firm emergence (Nicolaou and Birley 2003, Hvide and Jones 2018; Åstebro et al. 2019) or survival (Shane and Stuart 2002). We instead focus on VC fundraising, an effort-sensitive outcome that can significantly alter a spin-out's trajectory through the expertise and networks of the VC firm (Hellmann and Puri 2002) and because it signals firm quality to prospective employees and clients (Lee and Wahal 2004). Although not the sole driver of success, the entrepreneurial finance literature consistently identifies VC affiliation as a pivotal intermediary that shapes the long-term outcomes of entrepreneurial firms (Gompers and Lerner 2001, Hsu 2004, Bernstein et al. 2016, Ewens et al. 2018).

Empirically, we capture VC affiliation through the *Raised VC* variable, which indicates whether a spin-out successfully raised funding from a VC firm. In the panel analysis, this variable is coded on an annual basis, tracking whether funding was raised in each successive year after the spin-out date. In the cross-sectional analyses, by contrast, we consider fixed horizons, asking whether funding was raised within one, two, or three years following the spin-out date. Data on spin-out fundraising are sourced from

Beauhurst, which compiles comprehensive records from administrative filings at Companies House.[9] These records report the amount raised, the fundraising date, and the investor categories for each funding round; enabling us to identify explicitly those rounds that involve VC firms. The dataset covers all fundraising rounds completed through October 3, 2024. Within this window, 42% of spin-outs in our sample obtained VC funding. This relatively high proportion underscores both the caliber of IP produced and the strength of the UK venture finance market.

We define the *University Stake*, our main independent variable, as the proportion of non-cash equity, that is, shares in a university spin-out allocated without payment, held by the university, relative to the total non-cash equity granted. By construction, this measure excludes any priced equity. Purchased shares reflect subsequent financing decisions rather than the initial allocation of ownership that stems from the university's IP.[10] Formally, it is calculated as follows:

$$University\ Stake\ = \frac{University's\ Non-Cash\ Shares}{University's\ Non-Cash\ Shares + Founding\ Team's\ Non-Cash\ Shares} * 100.$$

In our sample, the average university stake is 31.0%. Appendix F contains definitions and examples of our methodology for computing the university stake. In our main specifications, we treat non-cash shares held by university-affiliated funds and trusts as part of the university's stake; Appendix G documents these entities.[11]

[9] Comparison of funding round data from Beauhurst and PitchBook for spin-outs in our sample between 2011 and 2018 shows that Beauhurst includes 98% of the funding rounds listed in PitchBook, while PitchBook includes only 78% of those contained in Beauhurst. The difference is even larger for fundraising amounts, with Beauhurst tracking GBP 8,762.91 million and PitchBook tracking USD 4,018.37 million in total funding raised. This gives us confidence in using Beauhurst data for the funding rounds.

[10] Given that we are only considering the equity deal reflected in the relevant capitalization table, the present analysis cannot speak to how the university and founder stake are diluted with subsequent investments. In particular, we do not consider anti-dilution provisions.

[11] University-affiliated funds arise when UK universities delegate their commercialization activities to external IP firms, in some cases transferring partial or even full equity ownership to these entities. For example, Imperial College London fully outsources its commercialization services to Touchstone Innovations, while several other universities partially outsource these activities to dedicated investment vehicles (BEIS 2018, HE-BCI 2022). Trusts – such as NHS trusts – may also hold IP rights when scientists hold joint appointments across universities and hospitals. In our main analysis, equity held by these affiliated funds or trusts is treated as equivalent to direct university holdings, since both can assert IP claims that dilute founders' equity stakes. However, companies spun out solely from such affiliated funds or trusts, with no direct university presence on the capitalization table, are excluded from our sample.

We classify each spin-out's IP into three broad technology domains: life sciences, physical & chemical sciences, and digital & data. This classification serves two purposes: first, it anchors the bargaining process over university stakes, since comparisons are more meaningful within, rather than across, technological categories. Second, it controls for systematic cross-domain differences, as each domain may exhibit distinct propensities to attract VC. To construct this *Technology Class* variable, we draw primarily on companies descriptions from the Beauhurst dataset, supplemented by the domain knowledge embedded in OpenAI's GPT-5 Pro large language model, which enables a systematic classification process that limits reliance on idiosyncratic human judgment. For each spin-out, we apply the model in two stages: first, to generate a concise yet technically precise description of the underlying IP, and second, to assign technology classes. The distribution of spin-outs across these technology classes is balanced, with 35.3% in the physical & chemical sciences, 35.0% in life sciences, and 29.7% in digital & data. Appendix H details prompt design, illustrative outputs, and validation procedures.

Our identification strategy for the causal incentive effect, the impact of university stakes on VC fundraising success, relies primarily on an IV we call the *Precedent University Stake*. The construction proceeds as follows. For each spin-out, we identify all spin-out events at the same university that occurred in the twelve months prior to its own spin-out date. Two possibilities then arise. If the university produced other spin-outs in the same technology class, we restrict attention to those technologically comparable firms and define the precedent stake as the average university stake among them, discarding spin-outs in unrelated domains. If, however, no such technologically relevant precedent exists, we instead calculate the average university stake across all spin-outs from that university within the same time window, irrespective of technology domain.

Our second IV captures unexpected shifts in university stake policy. In June 2017 Imperial College London introduced its Founders Choice programme. Before that, Imperial had outsourced commercialization to Imperial Innovations (later renamed Touchstone Innovations), but in 2017 the

College began bringing these functions back in-house.[12] Founders Choice marked a sharp departure from policy practice: it allowed academics to retain up to 95% founding equity while still receiving light-touch support from Touchstone Innovations. As the left panel in the first row of Figure 1 shows, average university stakes fell by more than half, from 40% to 19%. The right panel documents the corresponding increase in the likelihood of securing VC.

The programme's success created legitimacy concerns for other leading universities, particularly Cambridge and Oxford, which faced mounting challenges in justifying their university stakes. The lower panels of Figure 1 provide evidence that both institutions ultimately followed Imperial's lead, with Cambridge reducing its stakes after April 2019 and Oxford after September 2019. We also observe a parallel increase in their spin-outs' odds of raising VC within two years. Accordingly, our *Top 3 Universities' Equity Policy Change* variable flags spin-outs at Imperial, Oxford, and Cambridge that were subject to this exogenous reduction in university stakes, a shift unrelated to the intrinsic quality of the affected ventures.

To date the timing of the policy changes, we use step-indicator saturation (Castle et al. 2015, Nielsen and Qian 2025), which suggests candidates for break dates across all observations. We then search for corresponding changes at the institutional level. This approach avoids ad-hoc timing assumptions and identifies June 2017 (Imperial), April 2019 (Cambridge), and September 2019 (Oxford) as the relevant breakpoints in university stakes. Appendix I discusses our application of step-indicator saturation.

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[12] Imperial Innovations, spun out as a wholly owned subsidiary of Imperial College in 1997, managed the university's commercialization activities for two decades. Rebranded as Touchstone Innovations in 2017, the company was acquired later that year by IP Group. In the same year, Imperial launched its Founders Choice programme. A report commissioned by the UK Department for Business, Energy and Industrial Strategy (BEIS), a government ministry that existed from 2016 to 2023, documents this development (BEIS, 2018).

Insert Figure I about here

To guard against alternative explanations for fundraising performance beyond the technology domain, we introduce additional controls operating at two levels, first, variables describing the company itself, and second, variables reflecting its founding team. Company-level controls include consideration of geography, institutions, and time. Geographic location, drawn from each Companies House filings, identifies whether the firm is based in *London*, the UK's sole Alpha++ global city (Beaverstock et al. 1999) and the national hub of VC activity. *University* records the institution that provided the IP on which the spin-out is founded, acknowledging that institutional prestige may shape investor perceptions.[13] We also include two types of time related variables. The *Fundraising Year* variable captures calendar-year fluctuations in the supply of VC, while the *Founding Year* variable denotes the year of the spin-out event. By construction, the founding year coincides with the firm's first year in the sample.

Founding-team controls capture attributes of the individuals who shape the trajectory of the spin-out. We record whether any manager has prior *Entrepreneurial Experience*, defined broadly to include the founding of any type of organization. We also note the presence of *Scientists-turned-Managers,* academics who played an active role in generating the core IP on which the spin-out is based and who leave academia to guide its commercial development. In addition, we identify whether there is an *MBA Founder*, as indicated by a Master of Business Administration degree. *Number of Founders* is measured as the total count of scientists and managers on the capitalization table.[14] Finally, we proxy for

[13] We attribute each spin-out to a single university, the one with the largest university stake. We never attribute a spin-out to multiple universities, even when more than one university holds equity (e.g., due to inventor mobility). If two universities hold equal stakes, we assign the spin-out to the university with the higher spin-out activity, measured by the total number of spin-outs it produced over the full sample period. This tie-breaking rule ensures that attribution aligns with the university most likely to provide relevant precedent deals, thereby strengthening the relevance of our *Precedent University Stake* variable.

[14] Because founding teams can be very large (up to 17 founders, often when PIs include all lab members who contributed to the IP), we top-code this variable at 3. In larger teams, hierarchies typically emerge: a small subset functions as the venture's de facto top management team with strategic decision-making authority, while others may hold equity without founder-level influence (Eesley et al. 2014).

scientific seniority, we construct a *Professor Founder* variable, coded as one if any scientific founder held a professorship at the time of founding.

4. What Determines University Stakes?

We begin by estimating a cross-sectional ordinary least squares (OLS) model in which the dependent variable is the *University Stake*. The baseline specification includes university and founding-year fixed effects, together with company-level control variables for geography and technology class, estimated on a sample of 471 spin-outs.[15] We then extend the specification in stages: first by adding founder-level characteristics and then by introducing our two IVs as additional control variables. This section is descriptive and documents correlations between university stakes and spin-out characteristics.

Table 3 reports the determinants of university stakes in spin-outs. Column (1) shows *University Stakes* are approximately 8% higher in *Life Sciences* and *Physical & Chemical Sciences* than in *Data & Digital*, the omitted category. Column (2) adds founding team characteristics; prior *Entrepreneurial Experience* is associated with a reduction in *University Stake* of about 5%. Column (3) adds two more variables that will be our IVs: the *Precedent University Stake* (positive coefficient) and *Top 3 Universities' Equity Policy Shifts* (negative coefficient). With these instruments included, both *Professor Founder* and *MBA Founder* variables enter positively and significantly.

The results are consistent with the notion that equity stakes in university spin-outs are shaped by bargaining between universities and founders. Universities bargain harder when they perceive greater venture quality, consistent with Proposition 2: they capture higher stakes in *Life Sciences* and *Physical & Chemical Sciences*, where IP is more defensible, and they hold more firmly to precedent when founders bring credentials such as professorships or MBAs that signal commercial potential. Founders, in turn,

[15] The sample decreases from 649 to 471, because we keep the sample size constant across models and exclude 178 firms that have no precedent in our dataset.

bargain harder when they have prior entrepreneurial experience, which is associated with a notable reduction in university stakes. In this sense, realized equity shares reflect the push and pull between universities' efforts to capture value and founders' ability to resist those claims. While this analysis only captures observable effects, our IV approach also accounts for unobservable factors that may influence university stakes.

Insert Table 3 about here

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5. The Effect of University Stakes on VC Funding

We next analyse how university stakes affect the likelihood of securing VC funding. Part 1 presents the descriptive association between university stakes and funding outcomes, as well as the IV strategy used to identify the causal effect. Part 2 evaluates the robustness of these findings.

5.1. The Relationship of University Stakes and VC Funding

We begin by examining whether university stakes correlate with the likelihood of raising VC funding. Table 2 reports univariate comparisons: 46% of spin-outs with above-median university stakes secured VC, compared with 39% of those with below-median stakes. Table J.1, however, shows a pairwise correlation coefficient of 0.03 that is statistically insignificant. This result is inconsistent with the incentive-based prediction that higher university stakes weaken founder incentives and reduce the likelihood of VC funding. Instead, it suggests that selection effects may be at work. Proposition 2 of our theoretical framework suggests that universities may demand higher stakes precisely from the ventures that seem more promising. Such selection could offset or conceal an underlying negative causal effect.

To assess whether this pattern reflects observable differences in commercial potential across ventures, we estimate a pooled OLS regression on an unbalanced firm–year panel with university and fundraising year fixed effects, plus control variables for technology class, geography, and team characteristics. The fixed effects absorb persistent institutional differences in equity policies (e.g., Oxford's consistently higher stakes relative to Cambridge) as well as economy-wide shocks such as Brexit and COVID that shift VC supply or investor sentiment. The control variables proxy for venture attractiveness and thereby capture much of the observable selection. This specification provides a first step toward distinguishing incentive effects from selection.

Equation (1) is our pooled OLS specification, estimated as a linear probability model with standard errors clustered at the spin-out level i to allow for serial correlation in ε_{it} across years:

$$Raised\,VC_{it} = \alpha + \beta\, University\,Stake_{i} + \gamma\,' X_{i} + \mu_{u} + \delta_{t} + \varepsilon_{it}. \quad (1)$$

The dependent variable, $Raised\,VC_{it}$, equals one if spin-out i secures VC in year t. The key regressor is $University\,Stake_{i}$. The vector X_{i} contains control variables describing the spin-out and its founding team. The term μ_{u} captures university fixed effects, while δ_{t} captures fundraising-year fixed effects. Once a spin-out raises funding, we remove it from the panel in subsequent years, because our focus is the probability of initial VC fundraising success. Our coefficient of interest, β, captures the marginal effect of university stakes on the likelihood of raising VC.[16]

The results are shown in Table 4, columns (1) and (2), without and with control variables. In both specifications β is positive but statistically insignificant. The effect is modest: an estimated coefficient of 0.0007–0.0009 implies that a one percentage point increase in university stakes raises the probability of VC funding in a given year by less than 0.1 percentage point. Importantly, this magnitude remains similar

[16] We also estimate the specification using a probit model, which is well suited to binary outcome variables. The results are the same across the two approaches: the coefficients have the same signs and levels of statistical significance, and their magnitudes are very close. While the probit model enforces a nonlinear probability structure bounded between 0 and 1, the linear probability model has the advantage that its coefficients are directly interpretable as changes in probability and relies on weaker assumptions.

when observable venture characteristics are added. Because Table 3 shows these observables are systematically related to university stakes, this stability reinforces that the absence of a negative relationship in Table 4 cannot be explained by selection on observables.

Insert Table 4 about here

To separate the selection effect from the incentive effect, we turn to an IV strategy, following established practice in the entrepreneurship literatures.[17] We begin with pooled two-stage least squares (2SLS) regressions that including university and fundraising-year fixed effects, and then show that the results are robust to alternative specifications: cross-sectional regressions, university-by-year fixed effects, and an alternative IV that passes overidentification tests.

We begin by discussing our primary IV. The challenge is to identify a valid IV, one that shifts the university stake in a spin-out while remaining orthogonal to the venture's fundraising outcomes. Our logic rests on historical contingency: ventures that follow relevant predecessors who successfully bargained down the university's stake can credibly insist on similar terms.[18] This bargaining precedent affects the university stake but is unlikely to affect directly subsequent VC funding outcomes.[19]

Defining relevant precedent is non-trivial. Drawing on Link et al. (2015), we use three filters: institutional scope, recency, and technological similarity. Because equity practices vary widely across

[17] For related IV approaches, see Berger et al. (2005), Bottazzi et al. (2008), and Chemmanur et al. (2011).
[18] The role of precedent is deeply ingrained in UK society, a legacy of its common law tradition that manifests first and foremost in the legal system and, by extension, in societal institutions, including universities. See Lewis (2021) and related work by La Porta et al. (2008). The use of precedents to generate predictions has a long tradition in the finance literature, dating back to Fisk and Rimlinger (1979). It is also commonly used by financial practitioners to value firms using the investment comparables method (see Da Rin and Hellmann, 2020).
[19] The bargaining for the initial equity allocation was first studied in Hellmann and Wasserman (2017), who document that a large fraction of founding teams default to equal 50–50 equity splits, even when contributions differ. Such standardized allocations simplify negotiations and foster perceptions of fairness, yet they risk diluting incentives when founders' roles diverge. For university spin-outs, we also find that the most common equity split are 50–50 splits, with these conventions easing bargaining frictions but risking misaligned incentives.

universities, founders prioritize internal precedents from their own institution. Among these, recent spin-outs carry the greatest persuasive weight, because they reflect current technology transfer office (TTO) policies and negotiating posture, whereas older cases invite the rejoinder that "policy has changed." Technology class also shapes relevance: the nature of the IP, expected time-to-market, and TTO capabilities may differ across life sciences, physical & chemical sciences, and data & digital spin-outs. Accordingly, as detailed in Section 3.4, we define the *Precedent University Stake* as the equity share taken in prior spin-outs from the same university within the preceding 12 months of the focal spin-out date. Where possible, we first match technology class; if no same-class precedent exists, we relax the technology-class criterion while maintaining the 12-month look-back.[20]

We next assess the suitability of our IV, beginning with the relevance condition: the precedent set by prior spin-outs must influence the focal spin-out's equity deal. This influence can be understood as a peer effect, a mechanism well documented in prior work (e.g., Lerner and Malmendier 2013, Ahern et al. 2014). In our setting, university stake negotiations are governed by broad rules but leave discretion, giving founders room to invoke prior outcomes as credible benchmarks. Consistent with this mechanism, Table 3 shows that precedent stakes strongly predict focal stakes, even after controlling for university fixed effects. The broader UK-wide decline in stakes since 2010 reinforces this interpretation: bargaining outcomes are malleable and increasingly founder friendly, making local precedents especially salient in negotiations.

The exclusion restriction requires that prior peers affect the focal spin-out only through the university's equity negotiations and not through any other channel influencing venture performance. Characteristics of the focal spin-out itself cannot serve as valid IVs, since they are inherently tied to the university's equity stake and to the venture's commercialization potential. By contrast, the exogeneity of the *Precedent University Stake* rests on the fact that precedent deals involve other spin-outs whose

[20] We adopt a 12-month look-back as a pragmatic operationalization of "recency." University TTOs often review and revise equity and licensing practices on annual cycles, equity terms are sensitive to shifting venture market conditions, and in negotiation, precedents older than a year are more easily dismissed as outdated ("policy has changed"). A one-year window thus balances institutional realism, market relevance, and persuasive credibility.

commercialization prospects are unrelated to those of the focal firm. Moreover, because our specification includes both university and fundraising year fixed effects, the identifying variation arises only from differences in precedent deals within the same university and fundraising cohort. This feature further strengthens the case for the exclusion restriction, by ruling out confounding due to cross-university differences or time-specific shifts in dealmaking norms.

Our IV is closely related to the approach pioneered by Berger et al. (2005), who exploit local market conditions as a source of exogenous variation. In the VC literature, Bottazzi et al. (2008) and Chemmanur et al. (2011) employ IVs that rest on a comparable exclusion restriction, namely geographic variation in funding availability. Additional applications of such IVs appear in Ewens and Marx (2018), González-Uribe and Reyes (2021), and Eldar and Grennan (2024).

We estimate a 2SLS regression of the probability of raising VC, using the *Precedent University Stake* as an IV for the *University Stake*. Table 4, Columns (3) and (4) report the results without and with the additional control variables. In the first stage, closely mirroring Column (3) of Table 3, the IV proves highly significant at the 1% level, with a Sanderson–Windmeijer multivariate F-statistic of 10.46 and 11.08.[21]

In the second stage, once we correct for the selection effect, the results shift dramatically. Whereas the OLS estimates suggested a small, positive, and statistically insignificant effect, the instrumented coefficients flip sign and become negative and statistically significant. This reversal is our first key finding: it confirms Proposition 1's prediction that larger university stakes reduce the probability of raising VC. The magnitude of the effect is economically meaningful: a 10-point decrease in university stake increases the probability of raising VC by 8–10 percentage points per year. Finally, the downward

[21] Because the first-stage F-statistic is only modestly above conventional thresholds, we also conduct the Anderson–Rubin Wald test. The results confirm that our second-stage coefficients remain negative and significant, alleviating concerns about weak instruments. Specifically, the Anderson–Rubin Wald test yields p-values of 0.0006 and 0.0046, both well below conventional significance thresholds. Since the Anderson–Rubin procedure is robust to weak instruments, this reinforces that our IV results are robust to weak identification.

adjustment relative to the OLS estimates aligns with Proposition 2, which highlights how positive selection into higher university stakes biases OLS estimates upward.

5.2. The Robustness of the Estimated Relationship

To ensure our findings are not driven by modeling choices, we test robustness across cross-sectional regressions, university-by-year fixed effects, and an alternative IV that passes overidentification tests. The results remain robust, mitigating concerns about reliance on the panel structure or on the specific IV implementation.

5.2.1. Cross-sectional regression

We begin with the cross-sectional specification, since a natural concern is that our findings might hinge on the panel structure. To address this, we re-estimate the model without repeated firm-year observations. This exercise shows that our findings do not depend on the panel design but also hold in the simpler cross-sectional analysis.

In these cross-sectional regressions, we estimate the probability that a spin-out obtains VC within one, two, or three years of its spin-out date, focusing on these horizons because most fundraising occur early in a venture's life. The model retains the same control variables as before but treats time differently: rather than tracking outcomes year by year, we include founding-year fixed effects to absorb period-specific shocks. We also include university fixed effects.

Table 5 tests whether our findings depend on the panel structure, that is repeated firm observations over time, or also emerge in a simpler cross-sectional design, where each spin-out is observed only once. The first stage remains strong ($F = 12.62$).[22] In the second stage, the coefficients are negative and statistically significant: a 1% increase in university stake lowers the probability of raising VC by 1.8 percentage points within one year, with only modest additional declines over two- and

[22] The first stage is identical across all cross-sectional models, as university stakes are determined at founding and unaffected by the choice of the fundraising horizon.

three-year horizons. Thus, the negative effect holds in the cross-sectional setting, showing that our results are not specific to the panel design.

Insert Table 5 about here

The pronounced effect in the first year after spin-out formation can best be understood through founder incentives. In the early stages of a spin-out, when there are few, if any, employees, the work of the founding team is the most important factor for raising initial VC rounds (Berstein et al. 2017), because the technologies are still in their embryonic state (Jensen and Thursby, 2001). As the venture matures, however, the firm performance relies more on factors such as market traction and contributions of early joiners. Indeed, Kaplan et al. (2009) show that firm business models are more persistent than their founding team. Consequently, the impact of university stakes on the likelihood of securing VC funding declines over time.

5.2.2. University-Year Fixed Effects

Our specification already includes separate fixed effects for universities and fundraising year. To further strengthen robustness, we next use combined university-by-fundraising year fixed effects instead. The benefit of this specification is that it eliminates residual concerns about time-varying university conditions, for example, if the TTO expands support to founders over time or if the university develops stronger VC networks that facilitate investor introductions.

One immediate concern is that our IV, *Precedent University Stake*, relies on temporal variation in university stakes. The more fine-grained university-year fixed effects might absorb all of this variation. However, two considerations mitigate this concern. First, *Precedent University Stake* varies across technology classifications, incorporating only prior spin-outs from the same category when available. Accordingly, spin-outs founded in the same calendar year can still differ in their precedent stakes because

of these temporal and technological distinctions. This ensures that meaningful variation remains beyond what is absorbed by university-year fixed effects. Second, our IV uses a one-year look-back window anchored to each firm's spin-out date, not the calendar-year intervals that define the fundraising-year fixed effects. Hence, even spin-outs established within the same calendar year have distinct historical windows informing their precedent stakes, provided their spin-out dates differ.

Results are reported in Table 6. The OLS estimates remain positive and statistically insignificant, while the 2SLS coefficients turn negative and statistically significant, closely aligning with our baseline magnitudes. Because the more fine-grained fixed effects capture part of the temporal variation used by the IVs, the first-stage strength weakens, with the F-statistic dropping slightly below the conventional threshold of 10. Nonetheless, the Anderson–Rubin Wald tests remain valid under weak instruments and reject the null that instrumented university stakes have no effect on VC funding. The results in Table 6 reinforce our central conclusion: university stakes have a negative causal effect on the likelihood of VC funding.

Insert Table 6 about here

5.2.3. Alternative Instruments

Introducing a second IV further establishes the validity of our approach. Because the validity of a single IV cannot be tested directly, exclusion restrictions must be assessed jointly, typically through Hansen's J-test. These tests are most informative when the additional IV captures an orthogonal source of exogenous variation. To this end, we exploit the introduction of the Founders Choice scheme at Imperial College London in 2017 and the subsequent founder-friendly adjustments at Oxford and Cambridge, which represent unexpected policy shocks and provide a distinct source of exogenous variation.

The validity of the *Top 3 Universities' Equity Policy Shifts* IV rests on the claim that these policy shifts were exogenous, punctuated shifts in equity-holding practices rather than gradual adjustments tied to venture-level conditions.[23] Universities are typically viewed as institutionally inert, adjusting equity policies incrementally according to internal precedent (Hannan and Freeman 1984). The Founders Choice scheme at Imperial College London, however, was triggered externally by the expiration of a decade-long outsourcing agreement with Touchstone Innovation, which abruptly returned equity-policy authority to the university (Romanelli and Tushman 1994).[24] The subsequent policy shifts at Oxford and Cambridge reflected isomorphic pressures to maintain legitimacy (DiMaggio and Powell 1983).

A limitation of this IV is that the end of Imperial's outsourcing arrangement with Touchstone necessarily altered the organization of technology transfer, as commercialization functions were re-internalized. Although leadership continuity at the TTO helped mitigate the disruption, we cannot rule out that re-internalization affected the level of support available to spin-outs, creating a potential confound alongside the policy shift. In contrast, the later policy shifts at Oxford and Cambridge did not coincide with changes in TTO leadership or operations, suggesting they were not driven by shifts in commercialization capabilities but by isomorphic pressures (DiMaggio and Powell 1983). Such institutional co-movement between equity policy and technology transfer capabilities poses a general challenge in the literature (Hvide and Jones 2018). We therefore treat *Top 3 Universities' Equity Policy Shifts* as an alternative IV for robustness rather than as our baseline specification.

Table 7 probes robustness along the dimension of instrument validity by using the *Top 3 Universities' Equity Policy Shift*s variable as a second IV that provides an orthogonal source of exogenous variation. Columns (1) and (2) focus on the subsample of spin-outs from Imperial, Oxford, and Cambridge, providing a direct test of this IV. Columns (3) and (4) combine the *Top 3 Universities' Equity*

[23] See Section 3.4 for details on variable construction and Figure 1 for an illustrative plot of the instrument relevance.
[24] There is no evidence that the policy exchange was expected by scientists at Imperial College. Figure 1 does not indicate any pre-trend in the university stakes of Imperial prior to the policy change. There was also uncertainty if the programme would continue beyond the 18 month pilot phase.

Policy Shifts IV with *Precedent University Stake* in the full sample. Across all specifications, the IV estimates remain negative and statistically significant, whereas the corresponding OLS coefficients show no meaningful effect. Moreover, the policy shifts produce a much stronger first stage, with F-statistics above 19, mitigating concerns about weak instruments. The Hansen J statistic yields a p-value of 0.4, indicating that the overidentifying restrictions are not rejected. That the result holds under a distinct source of exogenous variation underscores the robustness of our estimated causal effect.

Insert Table 7 about here

We next extend the analysis to two related questions: whether university stakes affect the amount raised in the first VC round, and whether the effects generalize to equity funding more broadly. Appendix Table J.2 distinguishes between unconditional regressions including all spin-outs and conditional regressions limited to those that secure VC. The IV estimates indicate a negative and significant effect of *University Stakes* in the full sample, but the effect becomes statistically insignificant when restricting to firms that obtain VC. Turning to equity financing more broadly, Appendix Table J.3 shows a similar pattern: the IV coefficients are negative and statistically significant, whereas the OLS estimates are small, positive, and statistically insignificant. These findings therefore reinforce the central conclusion: larger university stakes reduce the fundraising performance of spin-outs, consistent with the mechanism that such ownership stakes distorts founder incentives to raise external capital.

6. Moderating Effects

Universities' equity policies shape founders' perceptions of the legitimacy and thereby moderate how university stakes influence fundraising outcomes. Building on Tost's (2011), we view these

perceptions as generalized legitimacy judgments. High university stakes can undermine instrumental, relational, and moral legitimacy, producing generalized illegitimacy that weakens founder effort and deters investors.

To implement this framework empirically, we classify universities by their initial university stakes. Specifically, we calculate each university's initial stake as the average university stake claimed in spin-outs during the institution's first year in our dataset. Universities with initial stakes above the median stake of 28.4% across all spin-outs are categorized as *High Initial University Stake,* while those below this threshold are classified as *Low Initial University Stake*.

In the *High Initial University Stake* category, equity claims are large enough to undermine incentives, appear unfair compared to peers, and risk being seen as exploitative. The simultaneous erosion of instrumental, relational, and moral legitimacy produces generalized illegitimacy. Consequently, founder effort declines, leading to a sharper fundraising penalty. In the *Low Initial University Stake* category, equity shares are modest enough to avoid generalized illegitimacy. At most, instrumental legitimacy is at issue, as founders may feel their incentives diluted, but relational and moral legitimacy remain intact. Indeed, entrepreneurial finance research shows that founders often voluntarily exchange small equity slices for valuable affiliations, such as with reputable investors (Hsu 2004). As a result, concerns are limited, and effects on founder effort and fundraising are muted.

Consistent with our theorizing, the results in Table 8 reveal a clear divergence. In the *Low Initial University Stake* group, university claims are too modest to generate generalized illegitimacy. The OLS estimates show only a weak positive association with fundraising, which disappears in the IV specification once we instrument for precedent stake levels. Concerns are therefore largely confined to instrumental considerations, with only limited effects on founder effort and fundraising performance. By contrast, in the *High Initial University Stake* group, the IV estimates uncover a statistically significant negative effect of university stakes on fundraising, comparable in size to our main estimates. These results

confirm that universities with systematically higher stake policies carry a sharper fundraising penalty, consistent with the erosion of legitimacy documented above.

Insert Table 8 about here

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7. Discussion

By estimating the causal effect of university stakes on spin-out initial VC fundraising, we show that incremental increases in the *level* of university value capture reduce value creation by academic entrepreneurs. This contribution complements prior work on the Professor's Privilege (e.g., Hvide and Jones 2018, Åstebro et al. 2019), which examines *who* owns the IP generated by scientists (universities or researchers) and shows that the presence or absence of university value capture affects entry.[25] Jensen and Thursby (2001) analyze *what form* of value capture universities should prefer (royalties or equity), and argue for equity's advantages. We qualify their claim by showing that the amount of equity taken shapes entrepreneurial value creation. Finally, our study differs from Ulrichsen et al. (2022, 2024), who rely on correlational methods and find little evidence that higher university stakes hinder fundraising.

Building on Jensen and Thursby's (2001) characterization of the TTO as a mediator between university and scientist interests, a growing literature has examined the TTO decision-making quality. Hsu and Kuhn (2023) find that TTOs often favor academic stars over experienced commercializers, leading to inefficiencies in resource allocation. Similarly, Mowery et al. (2002) suggest that many universities entering patenting in the 1980s initially pursued faculty inventions somewhat indiscriminately, but that

[25] The literature on the abolition of the Professor's Privilege in the early 2000s (Czarnitzki et al. 2015, Hvide and Jones 2018, Martínez and Sterzi 2021) examines a discontinuous regime shift: universities went from holding no equity in spin-outs to claiming up to 50%. Scientists thus faced two simultaneous shocks: a sharp increase in the university stake and higher transaction costs, the latter arising because universities first had to assert their IP rights and then design the legal and administrative structure of the new venture, including their equity share.

patent quality improved over time as these institutions developed stronger screening capabilities. We extend this work by documenting a new weakness in TTO decision-making: universities initially set excessively high stakes, which discouraged fundraising. We then show that universities gradually adjusted, with the average university stake in the United Kingdom declining from 33.2% to 24.4%.

Our evidence speaks directly to the debate on what motivates scientists to engage in commercialization. Survey-based studies, such as Cohen et al. (2020), suggest that prosocial motives not financial ones, primarily drive scientists' commercialization efforts. In contrast, Lach and Schankerman (2008) provide early evidence that financial incentives matter, showing that universities with higher royalty shares earn more licensing income. Lam (2011) reconciles these perspectives by demonstrating that commercialization motives are heterogeneous, with financial incentives salient for a subset of more entrepreneurial scientists. Moving beyond survey data, we use administrative records, combined with an instrumental variable strategy, to provide new evidence that financial motives matter in the spin-out context.

Although our analysis centers on the UK, it points to a broader pattern: university stakes shape founder incentives across institutional contexts. In much of Europe, national employee-invention laws similar to the UK Patents Act assign universities to scientists' inventions. In China, the 2015 reform of the Law on Promoting the Transformation of Scientific and Technological Achievements authorized universities to convert IP into equity without prior government approval. In both settings, universities often claim stakes near 50%, a level at which our evidence predicts generalized illegitimacy judgments. In the United States, the Bayh-Dole Act gives universities ownership of federally funded inventions, yet for spin-outs commercializing such technologies, universities typically take only small, single-digit stakes (see Columbia University Technology Ventures 2020). At these lower levels, researchers may accept the equity tradeoff in return for the reputational and network benefits of a university affiliation (Hsu 2004).

Our paper also relates to a broader comparative literature on ownership and firm performance. Prior work has examined managerial ownership (Morck et al. 1988, Himmelberg et al. 1999), family

ownership (La Porta et al. 1999, Anderson and Reeb 2003), common ownership by large institutional investors (Azar et al. 2018, Antón et al. 2023), and state ownership (Shleifer and Vishny 1994, Megginson and Netter 2001). Against this backdrop, we conceptualize university ownership as a distinct form of concentrated ownership. Like state owners, universities can reduce reliance on external finance, but their logic of value capture is bureaucratic rather than political. Unlike families, they do not seek dynastic control but redistribute resources within their ecosystem. Unlike dispersed or common owners, their bargaining power stems from IP rights rather than financial stakes. By situating university ownership alongside these categories, our findings extend the comparative ownership and performance debate to a new institutional form, especially salient in deep tech sectors (Arora et al. 2024).

Naturally, our study has limitations that create opportunities for future research. Spin-outs typically involve detailed contracts that outline not only equity allocations but also key licensing terms (Savva and Taneri 2015). Such data are not publicly available and would require access to confidential agreements. Moreover, our analysis centers on spin-outs in which the university holds a positive equity stake, not on university-based startups such as so-called "sneakouts," where the university holds none (Avnimelech and Feldman 2015). Given the scarcity of "deep pools of domestic risk capital" (The Telegraph 2017) outside the US, spin-outs often turn to international investors in later fundraising rounds. This raises the question of how higher university stakes are perceived by US investors, who are accustomed to lower university stakes.

Universities as equity holders in technology companies exert a distinctive influence on the firms they own. By virtue of owning the underlying IP, they appear on the capitalization table from the firm's inception. Historically, the degree of value capture has weighed heavily on academic entrepreneurs' financial motives. In the UK, however, TTOs appear to be learning. Equity stakes have trended downward, a shift reinforced by the influential government-commissioned report by Tracey and Williamson (2023), to which this study contributed evidence. The lesson is clear: The full entrepreneurial

potential of universities is unlocked only when equity policies align founder incentives with the labors of turning embryonic inventions into commercial enterprises.

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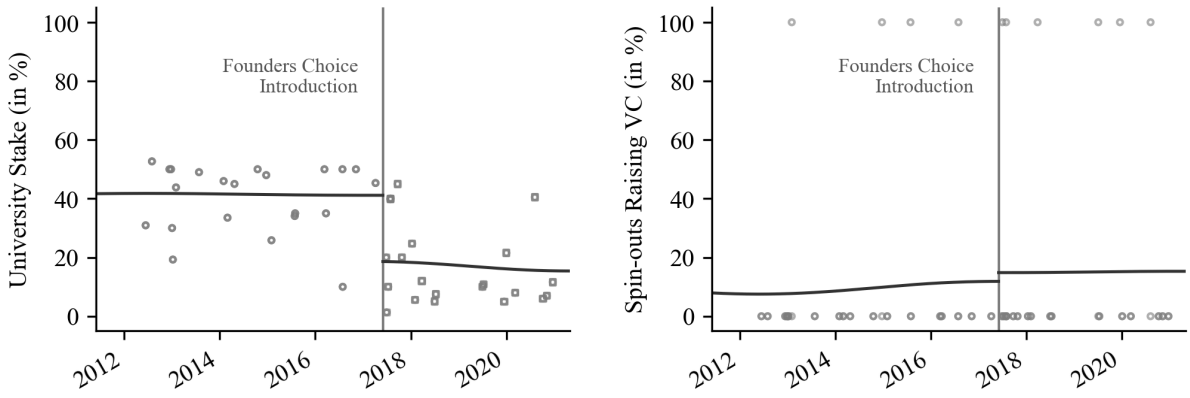
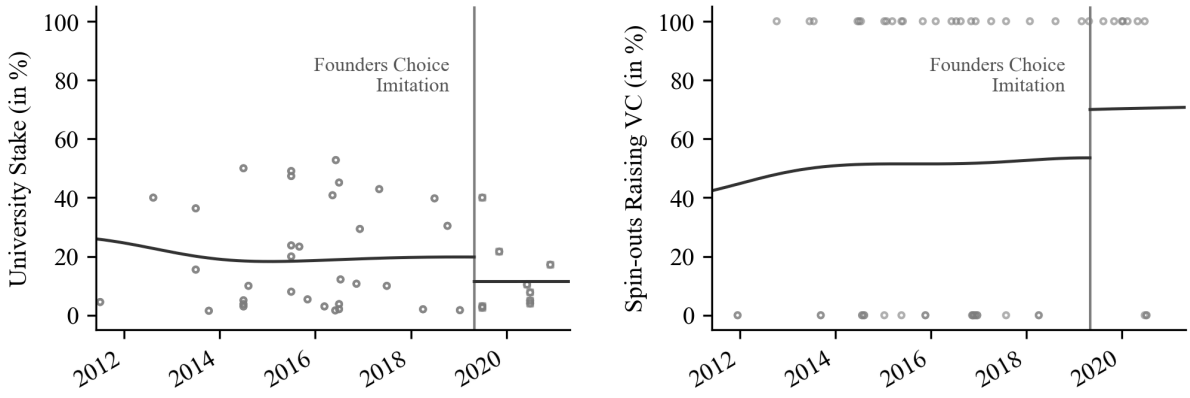
Figure 1. The Founders Choice Shock and Its Followers

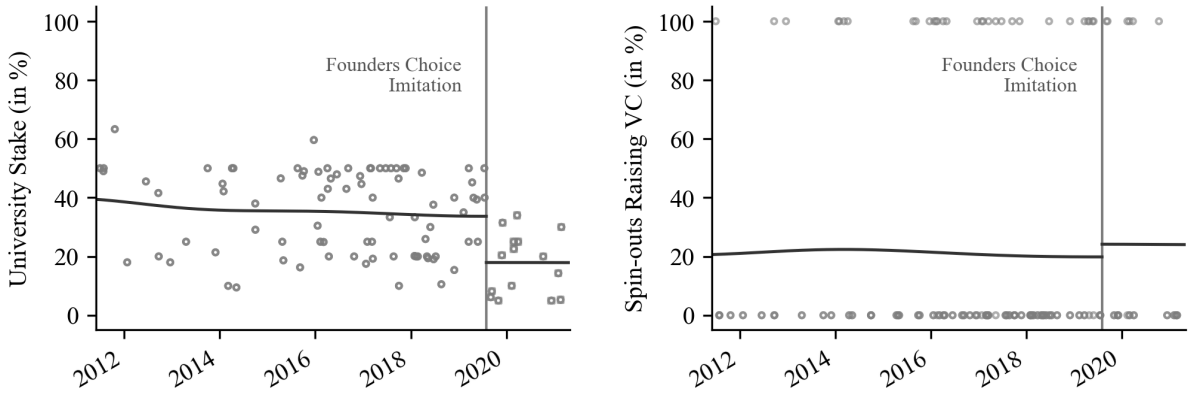
(a) Imperial College London (Shock timing: June 2017)



(b) University of Cambridge (Shock timing: April 2019)



(c) University of Oxford (Shock timing: September 2019)



Notes. This figure plots university spin-outs for Imperial, Cambridge, and Oxford. Left panels report university stakes; right panels report whether the firm raised VC within two years. Points represent firm-level observations. Vertical lines mark policy changes. Solid curves are nonparametric trends estimated separately for pre- and post-policy periods: university stakes are smoothed monthly medians of *University Stake* using a Gaussian kernel, and VC trends are smoothed monthly averages of *Raised VC,* weighting by the number of spin-outs. Both use a 24-month bandwidth.

Table 1. Variable Definition

Variable Names	Descriptions	Main Source
Dependent Variable		
Raised VC	Dummy variable equals 1 if the spin-out received VC investment; coded annually in the panel and as separate indicators for one, two, and three years in the cross-sectional analyses.	Beauhurst
Main Independent Variables		
University Stake	University's equity share in the spin-out at the time of founding, expressed as a percentage from 0 to 100.	CoHo
Precedent University Stake	Average university equity in spin-outs from the same university within one year prior to the focal spin-out date; calculated within the same technology class when such spin-outs exist.	Author's calc
Top 3 Universities' Equity Policy Shifts	Dummy variable equals 1 if the spin-out originated from Imperial College London after June 2017, from the University of Cambridge after April 2019, or from the University of Oxford after September 2019; these dates correspond to when each university adopted equity stake–reducing policies.	Author's calc
Spin-out Characteristics		
Technology Class	Set of dummy variables for each spin-out's technology, based on the underlying IP commercialized: Life Sciences, Physical & Chemical Sciences, and Digital & Data.	Author's calc
University	Parent university of the spin-out, the institution employing the scientist founders who developed the IP and holding the university equity stake.	CoHo
London	Dummy variable equals 1 if the spin-out is located in London.	CoHo
Fundraising Year	Set of dummy variables for fundraising timing, defined by calendar year, with the first coded as the spin-out year.	Beauhurst
Founding Year	Set of dummy variables indicating the calendar year of the spin-out date.	CoHo
Founding Team Characteristics		
Number of Founders	Number of founders listed on the spin-out capitalization table, limited to a maximum of 3.	CoHo
Entrepreneurial Experience	Dummy variable equals 1 if at least one spin-out founder previously founded another firm.	LinkedIn
MBA Founder	Dummy variable equals 1 if at least one spin-out founder holds an MBA.	LinkedIn
Scientist-turned-Manager	Dummy variable equals 1 if a scientist who contributed to the IP underlying the spin-out also holds a managerial role in the spin-out.	LinkedIn
Professor Founder	Dummy variable equals 1 if at least one spin-out founder held a faculty position (assistant, associate, or full professor) at the parent university before the spin-out date.	Webpages

Table 2. Summary Statistics

	Full Sample			High University Stake	Low University Stake
	Obs.	Mean	Std. Dev.	Mean	Mean
Dependent variable					
Raised VC	649	0.4222	0.4943	0.4586*	0.3881
Main Independent Variables					
University Stake	649	31.0282	16.8398	46.0092***	16.9864
Precedent University Stake	471	29.8910	15.5943	36.2914***	23.5178
Top 3 Universities' Equity Policy Shifts	649	0.0709	0.2568	0.0223***	0.1164
Spin-out Characteristics					
Life Sciences	649	0.3498	0.4773	0.3917**	0.3104
Physical & Chemical Sciences	649	0.3529	0.4782	0.3885*	0.3194
Data & AI	649	0.2974	0.4575	0.2197***	0.3701
London	649	0.1479	0.3553	0.1274	0.1672
Founding Team Characteristics					
Number of Founders	649	2.5701	0.6586	2.5382	2.6000
Entrepreneurial Experience	649	0.2666	0.4425	0.2293**	0.3015
MBA Founder	649	0.0847	0.2787	0.0955	0.0746
Scientist-turned-Manager	649	0.6749	0.4688	0.6401*	0.7075
Professor Founder	649	0.7812	0.4138	0.8121*	0.7522

Notes. This table reports summary statistics for the full sample and for subsamples split by whether the university stake is above or below the median. *Raised VC* equals one if the spin-out received VC funding by the end of the sample period (October 3, 2024). Mean differences across subsamples are tested using two-sided Welch's t-test. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 3. Determinants of the University Stake

	DV: University Stake		
	(1)	(2)	(3)
Spin-out Characteristics			
Life Sciences	8.9144***	8.5387***	7.4455***
	(1.7524)	(1.7425)	(1.7193)
Physical & Chemical Sciences	8.3009***	8.2451***	6.6369***
	(1.8413)	(1.8243)	(1.8101)
London	-3.2842	-3.2955	-3.4017
	(2.4862)	(2.4545)	(2.3551)
Founding Team Characteristics			
Number of Founders		-2.0306	-2.1002*
		(1.2344)	(1.1861)
Entrepreneurial Experience		-4.6919***	-4.7018***
		(1.6382)	(1.5703)
Scientist-turned-Manager		-2.2729	-1.9237
		(1.5504)	(1.4877)
Professor Founder		2.8359	3.5193**
		(1.8158)	(1.7564)
MBA Founder		3.0145	4.6272**
		(2.4298)	(2.3440)
Main Independent Variables			
Precedent University Stake			0.1336**
			(0.0545)
Top 3 Universities' Equity Policy Shifts			-15.1323***
			(3.0389)
University Fixed Effects	Yes	Yes	Yes
Founding Year Fixed Effects	Yes	Yes	Yes
Observations	471	471	471
R^2	0.360	0.387	0.443

Notes. The dependent variable is the university stake at the spin-out level. All models are estimated by pooled OLS with an intercept. Robust standard errors are reported in parentheses. To ensure consistent sample sizes across specifications, the 178 spin-outs with missing precedent university stakes are excluded. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 4. The Effect of University Stakes on VC Fundraising

	Second-Stage IV Regressions DV: Raised VC			
	(1) OLS	(2) OLS	(3) IV	(4) IV
University Stake	0.0007	0.0009	-0.0081**	-0.0102**
	(0.0006)	(0.0006)	(0.0038)	(0.0042)
Life Sciences		0.0176		0.0723**
		(0.0185)		(0.0339)
Physical & Chemical Sciences		0.0119		0.0850**
		(0.0181)		(0.0348)
London		-0.0018		-0.0137
		(0.0292)		(0.0461)
Number of Founders		0.0299***		0.0081
		(0.0098)		(0.0194)
Entrepreneurial Experience		0.0189		-0.0420
		(0.0229)		(0.0349)
Scientist-turned-Manager		0.0248		-0.0083
		(0.0174)		(0.0283)
Professor Founder		0.0112		0.0512
		(0.0208)		(0.0348)
MBA Founder		0.0525		0.0509
		(0.0400)		(0.0471)
University Fixed Effects	Yes	Yes	Yes	Yes
Fundraising Year Fixed Effects	Yes	Yes	Yes	Yes
Number of Spin-outs	471	471	471	471
Observations	2427	2427	2427	2427
	First-Stage IV Regressions DV: University Stake			
Precedent University Stake			0.2113***	0.2095***
			(0.0653)	(0.0629)
F-statistic			10.46	11.08

Notes. This table reports pooled OLS and IV regressions on an unbalanced firm–year panel. The dependent variable equals one if the spin-out received VC funding in a given year after the spin-out event, until the first VC round or, if none occurs, until the end of the sample period. All regressions include an intercept. OLS and IV coefficients are reported, with standard errors in parentheses (clustered at the spin-out level). The sample excludes 178 spin-outs with missing precedent stakes. *University Stake* is instrumented using the *Precedent University Stake* variable (defined in Section 3.4).
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Cross-Sectional Estimates

	Second-Stage IV Regressions DV: Raised VC					
	1 year after spinout date		2 years after spinout date		3 years after spinout date	
	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
University Stake	0.0018	-0.0184**	0.0024*	-0.0261**	0.0022	-0.0272**
	(0.0014)	(0.0091)	(0.0014)	(0.0110)	(0.0015)	(0.0115)
Life Sciences	0.0136	0.1860*	0.0303	0.2736**	0.0959*	0.3470***
	(0.0500)	(0.0957)	(0.0533)	(0.1150)	(0.0564)	(0.1206)
Physical & Chemical Sciences	0.0176	0.1842*	0.0672	0.3021***	0.1232**	0.3657***
	(0.0498)	(0.0951)	(0.0531)	(0.1143)	(0.0561)	(0.1198)
London	0.0673	0.0008	0.0060	-0.0879	0.0338	-0.0631
	(0.0660)	(0.0839)	(0.0733)	(0.1008)	(0.0819)	(0.1058)
Number of Founders	0.0120	-0.0290	0.0473	-0.0105	0.0720*	0.0123
	(0.0321)	(0.0435)	(0.0338)	(0.0523)	(0.0367)	(0.0549)
Entrepreneurial Experience	0.0375	-0.0572	0.0253	-0.1084	0.0514	-0.0866
	(0.0511)	(0.0676)	(0.0553)	(0.0812)	(0.0566)	(0.0851)
Scientist-turned-Manager	0.0195	-0.0264	0.0283	-0.0364	-0.0021	-0.0689
	(0.0444)	(0.0537)	(0.0467)	(0.0645)	(0.0504)	(0.0676)
Professor Founder	0.0519	0.1092*	0.0298	0.1106	0.0420	0.1254
	(0.0526)	(0.0635)	(0.0553)	(0.0763)	(0.0578)	(0.0800)
MBA Founder	0.1174	0.1783**	0.0822	0.1680*	0.0533	0.1420
	(0.0783)	(0.0823)	(0.0816)	(0.0989)	(0.0829)	(0.1037)
University Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Founding Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	471	471	471	471	471	471
	First-Stage IV Regressions DV: University Stake					
Precedent University Stake		0.1942***		0.1942***		0.1942***
		(0.0633)		(0.0633)		(0.0633)
F-statistic		12.62		12.62		12.62

Notes. This table reports OLS and IV cross-sectional regressions of university stakes on VC fundraising success. The dependent variable equals one if the spin-out raised VC within 1, 2, or 3 years after the spin-out event. All regressions include an intercept. Robust standard errors are reported in parentheses. The sample excludes 178 spin-outs with missing precedent stakes. *University Stake* is instrumented using the *Precedent University Stake* variable.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Estimates with University-Year Fixed Effects

	Second-Stage IV Regressions DV: Raised VC			
	(1) OLS	(2) OLS	(3) IV	(4) IV
University Stake	0.0006	0.0008	-0.0098**	-0.0123**
	(0.0006)	(0.0006)	(0.0043)	(0.0050)
Life Sciences		0.0182		0.0825**
		(0.0193)		(0.0377)
Physical & Chemical Sciences		0.0104		0.0979**
		(0.0189)		(0.0393)
London		-0.0067		-0.0215
		(0.0311)		(0.0511)
Number of Founders		0.0253**		0.0004
		(0.0101)		(0.0215)
Entrepreneurial Experience		0.0136		-0.0603
		(0.0240)		(0.0395)
Scientist-turned-Manager		0.0286		-0.0083
		(0.0176)		(0.0300)
Professor Founder		0.0137		0.0651*
		(0.0212)		(0.0387)
MBA Founder		0.0543		0.0518
		(0.0434)		(0.0498)
University × Fundraising Year Fixed Effects	Yes	Yes	Yes	Yes
Number of Spin-outs	471	471	471	471
Observations	2427	2427	2427	2427
	First-Stage IV Regressions DV: University Stake			
Precedent University Stake			0.2026***	0.1963***
			(0.0713)	(0.0682)
F-statistic			8.07	8.27
Anderson-Rubin Wald test F-statistic			0.0019	0.0002

Notes. This table reports pooled OLS and IV regressions on an unbalanced firm–year panel. The dependent variable equals one if the spin-out raised VC funding in a given year after the spin-out event, until the first VC round or the end of the sample period. All regressions include an intercept and university-by-year fixed effects. OLS and IV coefficients are reported, with standard errors in parentheses (clustered at the spin-out level). The sample excludes 178 spin-outs with missing precedent stakes. *University Stake* is instrumented using the *Precedent University Stake* variable. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Estimates with Alternative Instrumental Variables

	Second-Stage IV Regressions DV: Raised VC			
	Imperial and Oxbridge		All universities	
	(1) OLS	(2) IV	(3) OLS	(4) IV
University Stake	0.0019**	-0.0109***	0.0009	-0.0079***
	(0.0009)	(0.0039)	(0.0006)	(0.0026)
Life Sciences	-0.0166	0.0643	0.0176	0.0609**
	(0.0315)	(0.0539)	(0.0185)	(0.0261)
Physical & Chemical Sciences	-0.0102	0.1150*	0.0119	0.0699***
	(0.0328)	(0.0624)	(0.0181)	(0.0262)
London			-0.0018	-0.0113
			(0.0292)	(0.0408)
Number of Founders	0.0035	-0.0188	0.0299***	0.0126
	(0.0206)	(0.0388)	(0.0098)	(0.0155)
Entrepreneurial Experience	0.0266	-0.0260	0.0189	-0.0294
	(0.0266)	(0.0443)	(0.0229)	(0.0288)
Scientist-turned-Manager	0.0550**	0.0141	0.0248	-0.0015
	(0.0264)	(0.0467)	(0.0174)	(0.0236)
Professor Founder	0.0740**	0.1478**	0.0112	0.0429
	(0.0342)	(0.0689)	(0.0208)	(0.0294)
MBA Founder	0.0480	-0.0133	0.0525	0.0512
	(0.0405)	(0.0724)	(0.0400)	(0.0443)
University Fixed Effects	Yes	Yes	Yes	Yes
Fundraising Year Fixed Effects	Yes	Yes	Yes	Yes
Number of Spin-outs	190	190	471	471
Observations	803	803	2427	2427
	First-Stage IV Regressions DV: University Stake			
Precedent University Stake				0.1543**
				(0.0671)
Top 3 Universities' Equity Policy Shifts		-13.3926***		-13.0940***
		(1.4290)		(3.1689)
F-statistic		19.30		19.42
Hansen J-statistic (p-value)				0.4016

Notes. This table reports pooled OLS and IV regressions on an unbalanced firm–year panel. The dependent variable equals one if the spin-out raised VC funding in a given year after the spin-out event, until the first VC round or the end of the sample period. All regressions include an intercept. OLS and IV coefficients are reported, with standard errors in parentheses (clustered at the spin-out level). The sample excludes 178 spin-outs with missing precedent stakes. *University Stake* is instrumented using both the *Precedent University Stake* and the *Top 3 Universities' Equity Policy Shifts* variables.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 8. Heterogeneous Effects

	Second-Stage IV Regressions DV: Raised VC			
	Low Initial Stake University		High Initial Stake University	
	(1) OLS	(2) IV	(3) OLS	(4) IV
University Stake	0.0020**	-0.0207	-0.0002	-0.0072**
	(0.0009)	(0.0187)	(0.0007)	(0.0033)
Life Sciences	0.0330	0.1431	0.0095	0.0487
	(0.0292)	(0.1142)	(0.0232)	(0.0329)
Physical & Chemical Sciences	0.0404	0.1232	0.0027	0.0675*
	(0.0282)	(0.0833)	(0.0240)	(0.0377)
London	0.0930*	0.0458	-0.0510	-0.0490
	(0.0532)	(0.1447)	(0.0332)	(0.0445)
Number of Founders	0.0537***	0.0339	0.0166	-0.0044
	(0.0174)	(0.0450)	(0.0131)	(0.0228)
Entrepreneurial Experience	0.0140	-0.1650	0.0190	-0.0138
	(0.0414)	(0.1519)	(0.0264)	(0.0332)
Scientist-turned-Manager	0.0526*	-0.0241	0.0030	-0.0085
	(0.0270)	(0.0876)	(0.0218)	(0.0270)
Professor Founder	0.0143	0.0766	-0.0129	0.0276
	(0.0284)	(0.0846)	(0.0320)	(0.0462)
MBA Founder	0.1127*	0.3895	0.0276	-0.0148
	(0.0658)	(0.2522)	(0.0465)	(0.0473)
Control Variables	Yes	Yes	Yes	Yes
University Fixed Effects	Yes	Yes	Yes	Yes
Fundraising Year Fixed Effects	Yes	Yes	Yes	Yes
Number of Spin-outs	234	234	237	237
Observations	1181	1181	1246	1246
	First-Stage for IV regressions DV: University Stake			
Precedent University Stake		0.1085		0.3215***
		(0.0855)		(0.0950)
F-Statistic		1.34		10.92

Notes. This table reports pooled OLS and IV regressions on an unbalanced firm–year panel. The sample is split into two subsamples: *Low Initial University Stake*, comprising universities whose initial average stake (in the first year they appear in the dataset) is below the sample median, and *High Initial University Stake*, comprising those above the median. The dependent variable equals one if the spin-out raised VC funding in a given year after the spin-out event, until the first VC round or the end of the sample period. All regressions include an intercept, university fixed effects, and fundraising-year fixed effects. OLS and IV coefficients are reported, with standard errors in parentheses (clustered at the spin-out level). The sample excludes 178 spin-outs with missing precedent stakes. *University stake* is instrumented using the *Precedent University Stake* variable.

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Appendix A. Theory Proofs

Appendix A.1. Proof of Proposition 1

The two main players are *U* for the university and *S* for the scientist-manager. At date 0, *S* has a scientific discovery, with the IP owned by the university. To turn the discovery into a potential spin-out, *S* must exert effort at a private cost $\frac{1}{2}e_q^2$. The probability of reaching the spin-out stage at date 1 is $q = q_0 + q_1 e_q$. With probability $1 - q$, no spin-out is formed and all parties receive zero utility going forward. If there is a spin-out at date 1, *S* must exert effort to raise VC, at a private effort cost $\frac{1}{2}e_r^2$. The probability of successfully raising VC is $r = r_0 + r_1 e_r$. With probability $1 - r$ no funding is raised and all parties again receive zero utility. With probability r, however, the spin-out achieves value x. For simplicity, the game stops at date 2, but x can also be interpreted as the expected value of a continuation game beyond date 2. Thus, x represents the pre-money valuation in the VC round, reflecting the joint value held by *S* and *U*.

The spin-out is controlled by *U* who takes an equity stake α_U, leaving the scientist with a stake $\alpha_S = 1 - \alpha_U$. We assume binding wealth constraints, so that neither party can buy out another party's equity stake. We also assume zero outside options for *S*.

To solve the model we start by looking at *S*'s utility at date 1, denoted by

$$v_S = rx\alpha_S - \tfrac{1}{2}e_r^2 = (r_0 + r_1 e_r)x\alpha_S - \tfrac{1}{2}e_r^2.$$

The first-order condition for the optimal e_r is $e_r = r_1 x(1 - \alpha_U)$. Substituting back yields $r = r_0 + r_1^2 x(1 - \alpha_u)$. Hence, r is a decreasing function of α_U. Formally, $\frac{dr}{d\alpha_U} = -r_1^2 x < 0$. ■

Appendix A.2. Proof of Proposition 2

Consider the following bargaining model. The university *U* has a default policy of taking an equity stake α_U^*. Spin-out founders always attempt to negotiate down this stake. Specifically, we assume that *S* always requests that *U* make a concession.

At date 1, *U* must decide whether to either adhere to its default policy (α_U^*), or make a concession and accept a lower stake. Sticking to the default policy requires *U* to incur bargaining costs $\kappa \in [0, \infty)$, with distribution $\Omega(\kappa)$. These costs can be avoided if *U* makes a concession, which involves giving up an equity stake δ, where $0 < \delta < \alpha_U^*$. Naturally, *U* does not wish to make the concession voluntarily, that is,

$$v_U(\alpha_U^* - \delta) < v_U(\alpha_U^*).$$

If U sticks to its default policy, it receives utility $v_U^{Def} = v_U(\alpha_U^*) - \kappa$. If instead U makes a concession, it receives utility $v_U^{Con} = v_U(\alpha_U^* - \delta)$. Thus, U prefers to stick to the default policy whenever

$$\Delta = v_U^{Def} - v_U^{Con} = v_U(\alpha_U^*) - v_U(\alpha_U^* - \delta) - \kappa > 0.$$

There exists a critical bargaining-cost level κ_1 such that $\Delta(\kappa_1) = 0$. For all $\kappa > \kappa_1$, bargaining costs are too high and U makes the concession. For all $\kappa < \kappa_1$, bargaining costs

are low enough for U to stick to its default policy. The probability that U sticks to the default policy (and thus retains a higher university stake) is given by $\Omega(\kappa_1)$.

We now examine how $\Omega(\kappa_1)$ depends on the quality of the spin-out, and focus on the success value x. Totally differentiating $\Delta(\kappa_1, x) = 0$, we get

$$\frac{d\Delta(\kappa_1,x)}{d\kappa_1}\frac{d\kappa_1}{dx} + \frac{d\Delta(\kappa_1,x)}{dx} = 0, \text{ where } \frac{d\Delta(\kappa_1,x)}{d\kappa_1} = -1.$$

Moreover,

$$\frac{d\Delta(\kappa)}{dx} = \frac{d}{dx}[v_U(\alpha_U^*) - v_U(\alpha_U^* - \delta)].$$

Using $r = r_0 + r_1^2 x(1 - \alpha_U)$, U's date 1 utility is $v_U = rx\alpha_U^* = r_0 x\alpha_U^* + r_1^2 x^2(1 - \alpha_U^*)\alpha_U^*$. It follows that

$$\frac{dv_U}{dx} = r_0\alpha_U^* + 2r_1^2 x(1 - \alpha_U^*)\alpha_U^*.$$

It is useful to define $\theta = (1 - \alpha_U^*)\alpha_U^* - (1 - \alpha_U^* + \delta)(\alpha_U^* - \delta)$. We can interpret θ as equivalent to the drop in $(1 - \alpha_U)\alpha_U$ produced by a small discrete reduction δ in α_U^*. We obtain after transformations

$$\frac{d\Delta(\kappa)}{dx} = r_0\delta + 2r_1^2 x\theta.$$

Next, note that

$$\frac{d(1-\alpha_U^*)\alpha_U^*}{d\alpha_U^*} = 1 - 2\alpha_U^*.$$

Thus, for all $\alpha_U^* < \frac{1}{2}$, we have

$$\frac{d(1-\alpha_U^*)\alpha_U^*}{d\alpha_U^*} > 0.$$

By the equivalence above, this implies $\theta > 0$, so that $\frac{d\Delta(\kappa)}{dx} > 0$. Thus, the critical value κ_1, below which *U* sticks to its default policy, is an increasing function of x. Therefore, the probability of sticking to the higher university stake, $\Omega(\kappa_1)$, is also increasing in x. This establishes Proposition 2 for $\alpha_U^* < \frac{1}{2}$.

For $\alpha_U^* > \frac{1}{2}$ and $\delta > 2(\alpha_U^* - \frac{1}{2})$, it is straightforward to see, using the symmetry of $\alpha_U(1 - \alpha_U^*)$, that $\theta > 0$ continues to hold. However, for $\alpha_U^* > \frac{1}{2}$ and $\delta < 2(\alpha_U^* - \frac{1}{2})$, we get $\theta < 0$. In this case, the condition for $\frac{d\Delta(\kappa)}{dx} > 0$ becomes

$$\theta > -\frac{r_0\delta}{2r_1^2x}.$$

For given values of α_U^* and δ, this condition holds provided r_0 is sufficiently small, r_1 is sufficiently large, or x is sufficiently large. ■

Appendix B. UK institutional background

In the 1990s, universities around the world created technology transfer offices whose work consisted of licensing out the patents to exploit scientific discoveries developed within their universities. Over a short period of time in the early 2000s, that pattern changed dramatically as most of the attention of technology transfer offices shifted to spin-out companies, which began to commercialize often-embryonic and 'proof-of-concept' discoveries (Ulrichsen 2019, Jensen and Thursby 2001). This highlights the growing importance of spin-out firms to bridge the gap between science and markets, and it is associated with two related developments. First, more capital has become available for spin-out firms, and in industries where the initial cost of experimentation has fallen, the "spray-and-pray" approach allowed VC investors to invest smaller amounts in a larger number of spin-outs (Ewens et al. 2018). Second, as the number of doctoral degrees in science, technology, engineering, and mathematics have exceeded the number of available academic jobs (Cyranoski et al. 2011), spin-outs offer alternative career paths for graduate students in these fields (Hayter et al. 2017).

Section 39 of the 1977 UK Patents Act created a legal framework that, over time, resulted in universities gaining control over the scientists' discoveries. Prior to the Act, many UK universities had long-standing policies of not claiming ownership of IP, largely as a response to earlier scandals involving fraudulent patent claims.[26] The 1977 Act gave ownership of employee inventions to the employer in situations where the invention was part of the employee's normal duties (Bently et al. 2022). The shift in IP ownership had significant implications for spin-outs: universities gaining ownership of the IP meant they could contribute it to spin-out firms in return for equity.

In 1987, and in a move similar to the 1980 US Bayh-Dole Act, Margaret Thatcher's government decided to transfer ownership of IP arising from government-funded research to universities where the IP was generated (Monotti and Ricketson 2003). This move was conditional on universities establishing mechanisms to encourage the exploitation of this IP, including establishing technology transfer offices (Richards 2012). Like the Bayh-Dole Act, the policy aimed at incentivizing universities to commercialize research funded by public funds.

[26] A prominent case of fraudulent patent claims prior to 1977 is known as the "Owen Case" at Oxford University. The case involved Professor Brynor James Owen, Director of the Institute of Agricultural Engineering. In the late 1920s and 1930s Owen sold patents related to sugar beet processing to a company called Sugar Beet & Crop Driers, claiming that his methods were superior, a claim that proved untrue. Since the university's name gave credibility to the patents and Owen was its employee, the university was deemed liable for GBP 750,000 (see Richards, 2012).

Appendix C. Sample Construction Methodology

This appendix details the filtering criteria applied to the initial sample of 1,103 spin-outs identified by Beauhurst. By applying these criteria, we refined our sample to 649 spin-outs. These criteria are essential to ensure the accurate measurement of the initial equity distribution between the founders and the university at the spin-out event.

Filtering criteria	Nr	Example	Reason for exclusion
Missing/incorrect CH filing	6	Capitalization table shows overall number of shares, but it does not show how they are devided between the founders and the university.	Unable to identify distribution of equity between the founding team and the university due to filing errors in the capitalization table.
No academic founder ownership	41	This could be due to many unobservable reasons: e.g. the academic founders may have sold their shares or the capitalization table has not yet been updated with the entire founding team.	None of the shareholders in any of the cap tables has an academic affiliation with the university. Hence, to avoid calculation errors in the University Stake, we exclude these spin-outs from our sample.
Startup instead of spin-out	9	Startups formed out of university incubators.	It is not clear that these are university spin-outs. Hence, we wish to minimize pollution of our sample by excluding companies where the university may not initially own the IP rights and, as a result, does not face the same choice of equity stake allocation as it does in university spin-outs.
RCA spin-out	56	It is not clear whether these are student startups or university spin-outs.	
Non-university spin-out	10	Spin-out of university spin-outs.	
Uni stake <1%	332	These include 323 spin-outs with a university stake equal to 0 and 9 spin-outs with a university stake greater than 0 but smaller than 1%.	We exclude the 0 university stake spin-outs in order to avoid any measurement error which comes from including in the sample academic startups where it is not certain if the university holds IP rights or not. We exclude the 9 spin-outs with a positive but negligable university stake to minimize noise from potential outlying observations.

Appendix D. Shareholder Classifications

Our paper focuses on how the initial division of ownership between the university and founders impacts the subsequent performance of spin-outs. To analyze this, we need to identify the members of the founding team and clearly distinguish them from other shareholders, such as investors, listed on the cap table. In Section 2, we differentiate between scientist founders, who develop the technology to be commercialized, and manager founders, who manage the newly formed spin-out. This appendix provides detailed definitions for each type of founder, as well as investors.

A **scientist** is defined as any shareholder who was involved in the development of the technology that the spin-out is exploiting. For some scientists, it was ambiguous whether they were involved in the development of the technology. For example, some scientists also regularly reinvest their savings as angel investors.[27] In these cases, we provide our team of research assistants the written guidance below to make a judgment call:

In some cases, the company website mentions explicitly that the shareholder was involved with the technology. In this case, we classify him/her as a scientist. In the case when we do not find such evidence, we base our classification on the shareholders' field of study and affiliation with a university before the spin-out event. If the shareholder was not affiliated with any university and did not study in a field related to the spin-out's activity, we classify him/her as a non-scientist. If the shareholder was affiliated with the university and studied/did research/taught in an area similar to the spin-out's area, we classify him as a scientist. If the shareholder was not affiliated with a university but did research in the same area where the spin-out is operating and has publication records (as well as potential links to the other scientist founders such as they co-authored papers or worked in the same lab in the past), we classify him/her as a scientist.

A **manager** is defined as any shareholder who held an executive position within the spin-out at the inferred spin-out date (see Appendix V for our method of inferring the spin-out date). Again, there can be ambiguity about what constitutes an executive position. The judgment call to determine whether a shareholder had an executive position relies on the following criteria:

If the job title/role within the spin-out is an executive/full-time position (e.g., CEO), we classify the founder as a manager. If the job title is not clear in distinguishing executive from non-executive (e.g., CTO, CSO, etc.) and the shareholder was an academic before the spin-out event but did not maintain his academic position (or maintained it only part-time) afterward, we classify the shareholder as a manager; if he maintained his academic position, we classify the shareholder as non-manager.

Note that these two categories are not mutually exclusive, such that a founder could fall into any of the following categories:

1. Scientists who developed the technology but who do not get involved in the management of the spin-out after the spin-out event (Remaining Scientists)
2. Scientists who give up their academic position and transition into managing the spin-out (Transitioning Scientists)
3. Managers who are brought in to run the spin-out, but who have not contributed to the technology (Outside Managers)

For our analysis, the spin-out founding team is composed of remaining scientists, transitioning scientists, and new managers. We also include as managers any external advisors who join during the launch stage of the spin-out.

[27] Jakob Foerster, a Professor in Artificial Intelligence at the University of Oxford, is an example of a professorial angel investor, who invests in spin-outs. These investments are unrelated from his research and the technologies developed therein.

An **investor** includes any shareholder who falls in any of the following categories:

1. Explicit evidence he/she/entity is an investor;
2. Wealthy individual with no clear employment link to the spin-out;
3. Representatives of investment funds;
4. Person holds (now or in the past) multiple positions as director/board member in different companies (classified as an investor even if they are listed as advisor/non-executive member in the spin-out website);
5. Family members of known founders-based on surname;
6. Family members of known investors, based on surname;
7. Pair of shareholders appearing in multiple spin-outs, not in overlapping fields – co-investment networks;
8. If no information is available about Y but they have the same stake as X who was classified as an investor, Y is to be classified as an investor;
9. AoA explicitly lists entity/person as investor;
10. Nominees for whom there is no information in Companies House, making it impossible to trace the identity of the owners.

Any other shareholder for whom we could not find any information is categorized as an unknown.

With the identity of each shareholder in the 'spin-out cap table' established, we can now detail our methodology for computing the university stake negotiated at the spin-out event. A crucial aspect of our methodology involves separating free shares from priced shares held by each shareholder. In some cases, this is straightforward using multiple filings in Companies House. However, there are more complicated cases where the information is incomplete. A natural assumption is that investors are the least likely to receive free shares. We extend this assumption to unknown shareholders as well. The rationale is that spin-out founding teams are usually easy to identify based on information from spin-out websites, university websites, academic papers, and news articles, making it very unlikely for unknown shareholders to be founders. Likewise, as Appendix VI demonstrates, there is no ambiguity in identifying the university or entities which hold shares on the university's behalf, making it very unlikely for unknown shareholders to hold shares on behalf of the university.

Appendix E. Method of Inferring the Spin-Out Date

This appendix outlines the methodology for determining the official spin-out date for university spin-outs, as this information is not disclosed by universities. Accurate spin-out dates are crucial for analyzing company performance post spin-out event. We infer these dates by examining administrative filings to Companies House, including the Certificate of Incorporation, Confirmation Statements, Articles of Association, and SH forms. We briefly discuss when each filing is required.

- Certificate of Incorporation signifies the formation of a company. It is issued on the date of incorporation, and contains a capitalization table (cap table).
- Confirmation Statements are filed annually thereafter to confirm that the information held about the company is up to date. They contain updates to the cap table.
- Articles of Association (AoA) set out the rules and regulations governing the internal management and operation of a company. Universities encourage spin-outs to file AoA at the spin-out event, so that the rights and responsibilities of shareholders are clearly spelled out (OUI, 2021).
- SH01 forms are filed when new shares are allotted. SH02 forms are filed when shares are subdivided. SH06 forms are filed when shares are canceled. UK companies are legally required to file SH forms within one month of the change in capital occurring. Each SH form specifies the effective date of the share-related actions.

Our definition of the spin-out date is based on the filing of the 'spin-out cap table,' which is the earliest cap table that includes the complete founding team and the university. These cap tables are found in either the Certificate of Incorporation or the Confirmation Statements. When the 'spin-out cap table' is included in the Certificate of Incorporation, the spin-out date is equal to the date of incorporation. However, if the Certificate of Incorporation's cap table is missing relevant shareholders, the Confirmation Statements will contain the 'spin-out cap table'. The date of the Confirmation Statement does not necessarily indicate the spin-out date, as the share-related actions could have occurred any time in the preceding year. In such cases, we use the SH forms to determine the spin-out date, as they record the exact date of the share-related actions that completed the cap table. If there is only a single SH form available, we can determine the spin-out date precisely. If there are multiple SH forms filed in the year before a Confirmation Statement includes the 'spin-out cap table,' we refer to the AoA. The table below defines how we infer the spin-out date based on the available filings:

Appendix F. Calculating University Stake - Non-Cash vs. Priced Equity

This paper investigates how the initial allocation of ownership between the university and the founding team, negotiated at the spin-out event, influences subsequent fundraising performance. The university's stake in these negotiations is based on the university's ownership of the IP used by the spin-out, regardless of any financial contributions. Conversely, scientists and managers are allocated non-cash equity to provide incentives during the stages of scientific discovery and commercialization. Consequently, when calculating the university's stake, we disregard investments made by external investors, the university itself, or the founding team. To do this, we differentiate between 'priced' stakes obtained through investments and 'non-cash' stakes obtained through IP ownership. Thus, in Section 3.4, we define the university stake as the percentage of non-cash shares owned by the university compared to those owned by the founding team members.

Why separate priced shares from non-cash shares? This subsection provides a rationale for separating non-cash stakes from priced stakes and explains why we only incorporate the former in the calculation of the university stake.

We begin by outlining why excluding investors' ownership stakes is crucial for calculating the university stake using the following example. Suppose we observe two spin-outs, A and B, with the following 'spin-out cap tables':

- Spin-out A has the following equity distribution: the scientist founder has 20 shares, the manager founder has 10 shares, investor 1 has 5 shares, investor 2 has 3 shares, and the university has 20 shares. Assume that the founders and the university hold non-cash shares, reflecting the equity deal negotiated at the spin-out event. Investors hold priced shares, which reflect investments made after the spin-out event.[28]
- Spin-out B negotiated the same deal with the university at the spin-out event as spin-out A, but there are no investors in the cap table: the scientist founder has 20 shares, the manager founder has 10 shares and the university has 20 shares. Assume that the founders and the university hold non-cash shares.

To calculate the university stake, the formula above only incorporates non-cash shares held by the university and the founders. This gives a university stake of 40%=20*100/(20+10+20) for both spin-out A and B. However, suppose we were to modify the formula to include the investor shares in the denominator. Then, the university stake for spin-out A would be 34%=20*100/(20+10+20+5+3), whereas for spin-out B the university stake would remain 40%. The inclusion of the priced investor shares resulted in the underestimation of the university stake.

Apart from priced shares held by external investors on the 'spin-out cap table', the founders, university and university-affiliated funds could themselves have invested. That is, their equity stake could be a combination of non-cash and priced stakes. Consider the example of spin-out C:

- Spin-out C negotiated the same deal with the university at the spin-out event as spin-outs A and B: the scientist founder has 20 non-cash shares, the manager founder has 10 non-cash shares, and the university has 20 non-cash shares. However, in spin-out C, the university also holds an additional 10 priced shares due to making an investment into the spin-out. As a result of the university's investment, spin-out C did not need to raise any additional external funding in the immediate period.

[28] Using our methodology of dating the spin-out event, as outlined in Appendix V, we find only 5 spin-outs in our sample with investment rounds before the spin-out date.

The university stake in spin-out C is the same as in spin-out A and B, 40%, when using our formula. However, if we included the university's priced shares in the formula, spin-out C would have overstated the university stake of 50% = 30*100/(20+10+30).

Which entities hold the non-cash university shares? We identify three entities that can hold non-cash shares in exchange for transferring or licensing IP rights to the spin-out firm: the university, university-affiliated funds, and trusts. Both university-affiliated funds as well as trusts take some of the IP rights away from the founding team. Our analysis treats the IP rights of these funds and trusts the same as those of universities and adds their non-cash equity stakes to the university's non-cash equity stake. Below, we provide exact definitions for each entity.

Definition F.1. The university category comprises entities on the cap table of a spin-out that fall into the following two criteria:

1. An entity identified by the university name (e.g., City University);
2. An entity not identified by the university name, but for which we find publicly available evidence that it holds non-cash shares on behalf of the university. These entities must, at some point in our sample period, fulfill the following criteria if they have share capital:
    - Be fully owned by the university (e.g., Cambridge Enterprise Ltd);
    - Be fully owned by an entity that was fully owned by the university at some point during our sample period (e.g., Ulive Enterprises Limited).

Definition F.2. The trust category comprises entities on the cap table of a spin-out that appear jointly with a university and which can claim IP ownership for any of the following two reasons:

1. Joint appointments of university scientists who developed the relevant IP at these trusts (e.g., Cambridge University Hospitals NHS Foundation Trust);
2. Research grants were provided by the trust to projects, which funded the scientists who created the IP as part of these projects (e.g., Cancer Research UK Ltd).

Definition F.3. The university-affiliated fund category comprises entities on the cap table of a spin-out that represent investment funds. These funds may or may not be owned by the university, but there is public evidence of an agreement for them to provide some or all of the technology transfer services to newly formed spin-outs. In exchange, the university transfers a portion or all of the non-cash shares to these entities. Examples include Oxford Science Enterprise Limited, Touchstone Business Ltd, and IP2IPO. Appendix VII contains the list of agreements between the universities and university-affiliated funds in our sample.

To identify universities, trusts, and university-affiliated funds on the cap tables of a spin-out, we rely on a number of sources: spin-out booklets, descriptions of the entity in Companies House records such as Articles of Association and Financial Statements, LinkedIn descriptions of people who were affiliated with the particular entity, news articles etc.

There were often cases where some of these sources would specify evidence of investments made by these entities. Hence, as described in the previous sub-section, the equity stake held by universities, trusts and university-affiliated funds in a particular spin-out could include both the equity received in exchange for transferring IP rights to the spin-out (non-cash stakes) and the equity received in exchange for investments into the spin-outs (priced stakes). We next describe our methodology of separating priced and non-cash stakes in detail.

Separating Non-Cash Shares from Priced Shares

Our goal is to distinguish non-cash shares from priced shares held by the university, university-affiliated funds, trusts, and founders. To achieve this, we begin by clearly explaining our

methodology for inferring the price per share paid by each shareholder and providing a definition for non-cash shares. We applied this methodology to all spin-outs whose cap tables include any of the following: a trust, a university-affiliated fund, or a university for which we found public evidence of making investments into spin-outs or startups. Additionally, we applied the methodology to certain outlier cases where the university had more than double the shares held by the founder in the cap table. In total, we used this methodology for 525 out of 649 spin-outs in our sample. We conclude this section with a few examples to illustrate our method.

The 'spin-out cap table,' which is found in the Certificate of Incorporation or subsequent Confirmation Statements, contains information on the identity of the shareholder, the number of shares held, and the share class. However, unless the 'spin-out cap table' is part of the Certificate of Incorporation, the price per share paid by each shareholder is not reported. To identify the price per share, we use SH01 forms, which provide the number, class, and price of the shares issued, as well as notes on non-cash considerations. Although SH01 forms do not identify the shareholder receiving the new shares, we can infer the price per share paid by a particular shareholder by combining information from the 'spin-out cap table' and the previously filed SH01 forms.

In the following cases, the information from the Certificate of Incorporation, the Confirmation Statement, and the SH01 forms filed in-between is sufficient to unambiguously identify the price per share paid by each shareholder:

Case 1: The 'spin-out cap table' is contained in the Certificate of Incorporation. In this case, there are no previously filed SH01 forms, but the cap table itself lists the price per share held by each shareholder.
Case 2: The 'spin-out cap table' is filed in a Confirmation Statement subsequent to the Certificate of Incorporation, and one of the following applies:

- *(Unique share price):* All shares issued in SH01 forms and at the Certificate of Incorporation have the same price per share.
- *(Explicit evidence):* The SH01 forms explicitly mention, under non-cash considerations, the number of shares allocated for licensing or transferring of IP rights.
- *(Share class):* Different share classes are issued in SH01 forms and at the Certificate of Incorporation, with a distinct price for each class. By examining the class of shares held by each shareholder listed in the Confirmation Statement, we can determine the price per share paid by them for the specific share class they hold.
- *(Share block):* The number of shares held by each shareholder is issued in separate blocks within/across the SH01 forms. In this case, we utilize the information on blocks to infer the price per share for shareholders holding a particular block.

However, there can also be more complicated cases where SH01 forms do not provide the information needed to unambiguously infer the price per share for each shareholder in the Confirmation Statement. Whenever we cannot allocate issued shares to shareholders based on the evidence listed in Case 1 and 2 above, we make the following pecking-order assumption:

Assumption F.4 (pecking-order). Issued shares, ordered from the lowest price to the highest, are allocated to shareholders in the following priority:

1. Founding team;
2. University, trusts and university-affiliated funds
3. Investors and unknown shareholders.

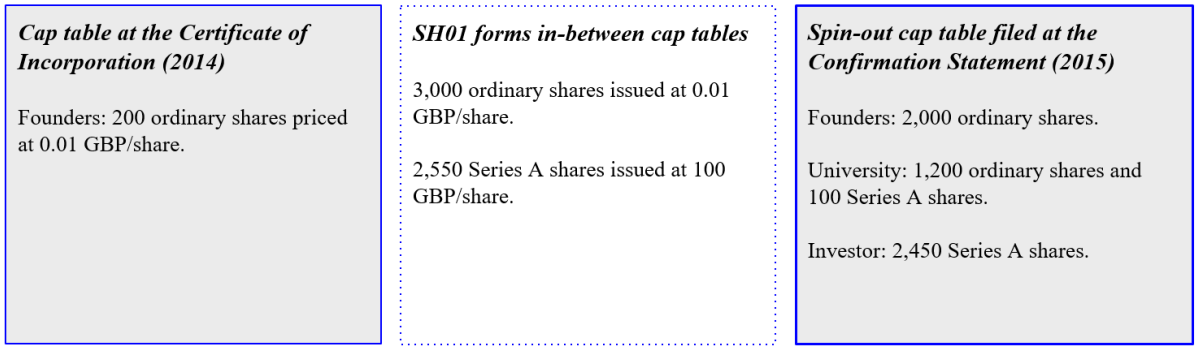
The pecking-order assumption suggests that founders are the most likely to receive the lowest-priced shares. Indeed, whenever there is sufficient information to unambiguously identify the price per share held by each shareholder, as in cases 1 and 2 above, we observe that founders tend to hold the cheapest shares. Investors are ordered as the least likely, alongside unknown shareholders. The

reasoning for including unknown shareholders in the last category is that spin-out founding teams can typically be identified easily using information from spin-out websites, university websites, academic papers, and news articles, making it improbable for unknown shareholders to be founders. Similarly, there is no ambiguity in identifying the university or other entities holding shares on its behalf, making it equally unlikely for unknown shareholders to represent the university.

The aforementioned methodology ensures we know the price per share paid by each shareholder on their holdings. In practice, shares issued in Companies House are not priced at exactly zero. Hence, to apply the formula for calculating the university stake, we need a reasonable definition of non-cash shares. We define non-cash shares as the lowest-priced shares held by the founding team. We use the lowest founder share price instead of the university's lowest share price because it could be that the university has received no non-cash equity stake in exchange for transferring the IP at the spin-out event, and has solely made an investment into the spin-out. With the definition of non-cash shares held by the university and the founders established, the formula for calculating the university stake follows as in Section 3.4.

The following examples illustrate our methodology to identify the price per share paid by each shareholder. Example F.5 and Example F.6 show how the class of shares and information contained in share blocks can be used to identify the price of shares paid by each shareholder, as described in Case 2. Example F.7 shows a simple application of Assumption F.4. Example F.8 shows a combination of exploiting share block information and Assumption F.4.

Example F.5 (share class). In this example we show how we can use the information on the share class held by each shareholder in the 'spin-out cap table' to infer the price per share paid. Consider the following illustration:



The spin-out was incorporated in 2014. However, the cap table in the Certificate of Incorporation does not include the university, so it does not provide information on the equity distribution at the spin-out event. Instead, the 'spin-out cap table,' which includes the founding team and the university, is filed in the 2015 Confirmation Statement. According to the 'spin-out cap table,' the founding team holds 2,000 ordinary shares, the university holds 1,200 ordinary shares and 100 Series A shares, and the investor holds 2,450 Series A shares. Note that the Confirmation Statement does not contain the price of the shares issued. Therefore, we also consider the previously filed SH01 forms and the Certificate of Incorporation. The Certificate of Incorporation and the relevant SH01 forms record the issuance of 3,200 ordinary shares priced at 0.01 GBP/share and 2,550 Series A shares priced at 100 GBP/share. As a result, we can infer that at the spin-out event, the founding team holds 2,000 ordinary shares priced at 0.01 GBP, the university holds 1,200 ordinary shares priced at 0.01 GBP and 100 Series A shares priced at 100 GBP, and the investor holds 2,450 Series A shares priced at 100 GBP. Using our definition of non-cash shares as the lowest-priced shares held by founders, we conclude that the founding team holds 2,000 non-cash shares and the university holds 1,200 non-cash shares. Thus the university stake is 38% = 1,200*100/(1,200+2,000).

Example F.6 (share block). In this example, we demonstrate how information about the blocks in which shares are issued can be used to infer the price per share paid by each shareholder. Unlike Example F.5, in this example, all shareholders receive only one share class: ordinary shares. However, the price paid by each shareholder need not be the same. Moreover, ordinary shares need not all be issued as a single block. Consider the following illustration:

Cap table at the Certificate of Incorporation (2014)	*SH01 forms in-between cap tables*	*Spin-out cap table filed at the Confirmation Statement (2015)*
Founders: 200 ordinary shares priced at 0.01 GBP/share.	1,800 ordinary shares issued at 0.01 GBP/share. 1,200 ordinary shares issued at 0.01 GBP/share. 2,450 ordinary shares issued at 50 GBP/share.	Founders: 2,000 ordinary shares. University: 1,200 ordinary shares. Investor: 2,450 ordinary shares.

As before, the 'spin-out cap table' is contained in the 2015 Confirmation Statement. According to the 'spin-out cap table,' the founding team holds 2,000 ordinary shares, the university holds 1,200 ordinary shares, and the investor holds 2,450 ordinary shares. To determine the price of the issued shares, we refer to the SH01 forms and the Certificate of Incorporation filed prior to the Confirmation Statement. The relevant SH01 forms record the issuance of shares in the following separate blocks: 1,800 ordinary shares at 0.01 GBP/share, 1,200 shares at 0.01 GBP/share, and 2,450 shares at 50 GBP/share. The Certificate of Incorporation records founders holding 200 ordinary shares priced at 0.01 GBP/share. Unlike the previous example, the SH01 forms do not record the issuance of all ordinary shares in a single block; rather, the issued shares are broken down into three blocks. In practice, this could represent three different SH01 forms recording the issuance of each block in turn, or a single SH01 form clearly distinguishing each block. Notice that the blocks in which shares are issued in the SH01 forms exactly match the blocks of shares held by the university and the investor. We thus infer that the founders' and the university's shares are priced at 0.01 GBP/share, while the investor's shares are priced at 50 GBP/share. Based on our definition of non-cash shares being the lowest-priced shares held by founders, the founding team holds 2,000 non-cash shares and the university holds 1,200 non-cash shares. Thus the university stake is 38% = 1,200*100/(1,200+2,000).

Example F.7 (pure pecking-order). In this example, we demonstrate when and how we apply the pecking-order assumption. Unlike Example A.VI, there is no information in the blocks in which the shares are issued in the SH01 forms, as they do not match the exact holdings of shareholders in the 'spin-out cap table'. Consider the following illustration:

Cap table at the Certificate of Incorporation (2014)	*SH01 forms in-between cap tables*	*Spin-out cap table filed at the Confirmation Statement (2015)*
Founders: 200 ordinary shares priced at 0.01 GBP/share.	3,700 ordinary shares priced at 0.01 GBP/share. 2,100 ordinary shares priced at 50 GBP/share.	Founders: 2,000 ordinary shares. University: 4,000 ordinary shares.

In the 2015 Confirmation Statement, founders hold 2,000 ordinary shares, while the university holds 4,000 ordinary shares. According to the relevant SH01 forms, a total of 5,800 ordinary shares are issued. Of these, 3,700 shares are priced at 0.01 GBP/share and 2,100 shares are priced at 50 GBP/share. The Certificate of Incorporation records founders holding 200 ordinary shares priced at 0.01 GBP/share. None of the blocks of issued shares in the SH01 forms match the exact holdings of the shareholders in the 'spin-out cap table'. Therefore, we rely on Assumption A.IV, which prioritizes founders in receiving the cheapest shares over the university. This suggests that founders hold 2,000 ordinary shares priced at 0.01 GBP/share, while the university holds 1,900 shares priced at 0.01 GBP/shares, and 2,100 shares priced at 50 GBP/share. Using our definition of non-cash shares, we conclude that the founding team holds 2,000 non-cash shares and the university holds 1,900 non-cash shares. Thus the university stake is 49% = 1,900*100/(1,900+2,000).

Example F.8 (share block and pecking-order). In this example, we demonstrate how the blocks in which shares are issued in the SH01 forms contain only partial information that may allow us to infer the price per share paid by some, but not all shareholders. In these cases, we use the information from the blocks where possible and rely on Assumption A.IV for the remaining shareholders. Consider the following illustration:

Cap table at the Certificate of Incorporation (2014)	***SH01 forms in-between cap tables***	***Spin-out cap table filed at the Confirmation Statement (2015)***
Founders: 200 ordinary shares priced at 0.01 GBP/share.	1,600 ordinary shares issued at 0.01 GBP/share. 1,200 ordinary shares issued at 0.01 GBP/share. 2,650 ordinary shares issued at 50 GBP/share.	Founders: 2,000 ordinary shares. University: 1,200 ordinary shares. Investor: 2.450 ordinary shares.

In the 2015 Confirmation Statement, founders hold 2,000 ordinary shares, the university holds 1,200 ordinary shares, and the investors hold 2,450 shares. SH01 forms issue the following blocks of shares: 1,600 ordinary shares priced at 0.01 GBP/share, 1,200 ordinary shares priced at 0.01 GBP/share, and 2,650 shares priced at 50 GBP/share. Because the block of university shares is issued separately at 0.01 GBP/share, the university is allocated 1,200 shares at 0.01 GBP/share. By our pecking-order Assumption A.IV, founders have priority when receiving non-cash shares over the investors. Hence, founders hold 1,800 shares priced at 0.01 GBP/share and 200 ordinary shares priced at 50 GBP/share. Investors thus hold 2,450 shares at 50 GBP/share. Based on our definition of non-cash shares, the founders hold 1,800 non-cash shares and the university holds 1,200 non-cash shares. The university stake is thus 40% = 1,200*100/(1,200+1,800).

Appendix G. Summary of the Deals between the Universities and University-affiliated Funds

This appendix details specific instances where universities outsourced their commercialization services to affiliated funds, resulting in these funds obtaining full or partial ownership of the university's non-cash shares. Our main analysis treats the IP rights associated with these funds as equivalent to those held directly by the universities, incorporating the non-cash equity stakes held by these entities into our calculation of the university stake. Hence, we provide a comprehensive list of such transactions during the study period that are relevant to the spin-outs in our sample.

- Imperial College London fully outsourced its commercialization services to Touchstone Innovations Group (BEIS 2018).
- IP2IPO Ltd had (partial) commercialization deals with the following universities: Bath University, Glasgow University, Southampton University, Leeds University, Bristol University, King's College London, Oxford University (IP2IPO Group 2005, IP Group 2006).
- Frontier IP Group has a commercialization agreement with the University of Plymouth (University of Plymouth 2022).
- Fusion IP has a commercialization agreement with the University of Sheffield and the University of Cardiff (Cardiff University 2013, Sheffield Clinical Research 2024, Proactive 2009).
- Oxford University had additional (partial) commercialization deals with Oxford Sciences Enterprises Ltd and Technikos LLP (University of Oxford 2023, The Engineer 2005).

Appendix H. The Creation of the Technology Class Variable

We construct the *Technology Class* variable by combining detailed company descriptions from the Beauhurst dataset with domain knowledge embedded in large language models. Beauhurst provides both a short "Description" field and a longer "Description in their own words" field. Using these, we develop informative prompts that distinguish each firm from others in the sample, and then employ OpenAI's GPT-5 Pro model to generate dense, single-sentence summaries of the technology underlying the intellectual property that the spin-out seeks to commercialize. Importantly, we do not rely on the OpenAI API; because our sample size is relatively small, batch processing through the ChatGPT interface proved sufficient.

The prompt to create the detailed technology descriptions is as follows. For the batch processing, we add information on 10 firms within each prompt, here illustrated with Hotspur Geothermal.

I will provide a list of firms with the following details: Companies House ID, Company Name, Spin-out Date, University, Description, and Description in their own words. For each firm, write a single, densely packed paragraph describing its core technology. Do not repeat any text from the provided "Description" or "Description in their own words," and omit any reference to the University, Spin-out Date, or phrases such as "At the time of the spin-out." Use your own knowledge, without searching the internet, to produce a detailed account of the technology as it existed at the time of the spin-out. Output the results in an Excel file with two columns: (i) Companies House ID and (ii) Core Technology Description.

— Firm 1 —

Companies House ID: 7207283
Company Name: Hotspur Geothermal
Spin-out Date: 2010-03-30
University: Newcastle University
Description: Hotspur Geothermal provides geothermal project development services including drilling, exploration and consultancy for the purposes of producing renewable energy.
Description in their own words: Hotspur Geothermal (formerly Cluff Geothermal) is a British geothermal development company. Hotspur Geothermal is well placed in the geothermal energy sector with expertise in geothermal development, natural resources, drilling and other renewable energy technologies. Specialising in East Africa, we use our technical and financial expertise to deliver successful geothermal energy projects. The company was founded in 2010 with a focus on deep geothermal heating projects in the North East of England, and subsequently expanded its portfolio of operations overseas. Recent experience has included an extensive surface exploration programme on its exploration licence in the Main Ethiopian Rift; geothermal drilling in Kenya for the Government of Kenya; and geothermal consultancy in the United Kingdom and abroad for private developers and Governments. Geothermal energy is increasingly recognised as one of the most important renewable sources of energy available. It is one of the most efficient sources of power in the world; it has a low surface footprint; and unlike most renewable energy types, it is a non-intermittent, baseload energy source available 24/7. Able to provide heat as well as electricity, geothermal energy is a technology that is growing fast and will play an ever-increasing part in delivering clean, affordable renewable energy. Hotspur Geothermal is a limited company registered in England and Wales.

For Hotspur Geothermal, the technology description sentence that the large language model generates is: "Integrated subsurface toolkit—magnetotellurics/seismic, geothermometry, reservoir simulation—and high‑temperature well design (HPHT fluids, lost‑circulation control, corrosion‑resistant completions) coupled to ORC/district‑heat interface engineering to de‑risk deep resource appraisal and deliver productive wells."

Based on the detailed descriptions, we feed all technology descriptions to the GPT-5 Pro model to suggest technology categories using the following prompt:

Goal: Produce output in a tidy, long-form table where each row is a (company, technology) mapping in the CSV format.
Structure:
company → the company house number
categories → assign all the relevant slugs from the list below
List: life sciences, physical& chemical sciences, and digital & data

The large language models output a categorical assignment of each firm into one of the three technology domains. For firms that plausibly span multiple domains, the prompt requires a single primary classification. Before incorporating this new *technology class* variable into the empirical analysis, we systematically verified the quality of the classifications. Specifically, we drew a sample of 20 firms and conducted a careful validation exercise, drawing on their company webpages, associated academic publications, and patent filings. This verification confirmed that the classifications were defensible for all firms in the sample.

Appendix I. Identification of Breakpoints in University Stakes Using Step-indicator Saturation

We implement step-indicator saturation using the gets package in R and apply the algorithm to the time series of university stakes at Imperial College London (47 spin-outs), the University of Cambridge (47 spin-outs), and the University of Oxford (102 spin-outs). For each series, we track the sequence of spin-out events rather than their calendar dates, since the step-indicator saturation algorithm does not account for the temporal distance between events. Accordingly, "time" in our setting reflects the order of spin-out creation rather than clock time, and the number of observations in each series equals the number of spin-outs in our sample.[29]

The step-indicator saturation algorithm requires a tuning parameter, the *gauge*. As shown by Nielsen and Qian (2025), the gauge is asymptotically linked to the expected number of false positive structural breaks identified when the data-generating process contains none. We set the gauge to 5%, reflecting a deliberate tolerance for false positives: because we already have independent knowledge of underlying changes in university equity policies, our concern is less about spurious breaks than about missing relevant ones. In practice, we use step-indicator saturation to generate candidate break dates, which we subsequently interpret in light of institutional policy shifts.

For Imperial College London, the algorithm identifies five potential break dates, June 27, 2017, July 28, 2017, October 24, 2017, August 6, 2020, and October 7, 2020. We observe three spin-outs with unprecedentedly low university stakes in June and July, which leads us to select June 27, 2017 as the selected break date so as to include these cases within the exposed category. This timing indicates that Imperial had already begun lowering university stakes prior to the formal announcement of the Founders Choice programme in August 2017, consistent with anecdotal evidence from interviews with leaders of Imperial's technology transfer office.[30] At this break, the average university stake fell by roughly 30 percent.

For the University of Cambridge, the algorithm detects a single structural break on April 23, 2019, after which the average university stake is 14.3 percent lower. For the University of Oxford, the algorithm identifies two break dates, January 24, 2012, and September 4, 2019. Since only one of these occurs after the launch of Imperial's Founders Choice programme, we select September 4, 2019 as the relevant break point. Following this break, Oxford's average university stake declined by 17 percent.

[29] In a few cases, multiple spin-outs share the same spin-out date. In this case we shift the spin-out date upward for randomly selected affected firms by as few days as possible.

[30] See the official webpage of Imperial College London, which dates the Founders Choice to August 2017 (https://www.imperial.ac.uk/enterprise/about/data-and-reporting/metrics-2017-18/academics/, accessed 25 August 2025).

Appendix J. Additional Tables

Table J.1. Pairwise Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) *Raised VC*	1.00											
(2) *University Stake*	0.03	1.00										
(3) *Precedent University Stake*	-0.07	0.43***	1.00									
(4) *Top 3 Unis' Equity Policy Shifts*	0.07*	-0.25***	-0.19***	1.00								
(5) *Life Sciences*	0.11***	0.09**	0.10**	0.01	1.00							
(6) *Phys. & Chem. Sciences*	0.03	0.09**	0.10**	-0.04	-0.54***	1.00						
(7) *Data & AI*	-0.15***	-0.19***	-0.21***	0.03	-0.48***	-0.48***	1.00					
(8) *London*	-0.03	-0.07*	0.02	0.16***	0.02	-0.09**	0.07*	1.00				
(9) *Number of Founders*	0.20***	-0.11***	0.06	0.11***	0.04	0.02	-0.06	0.02	1.00			
(10) *Entr. Experience*	0.09***	-0.11***	0.03	0.05	0.00	0.04	-0.04	0.05	0.27***	1.00		
(11) *MBA Founder*	0.12***	0.00	-0.03	0.11***	0.01	-0.03	0.02	-0.02	0.14***	0.20***	1.00	
(12) *Sci.-turned-Manager*	0.03	-0.10***	-0.03	0.08*	-0.06	-0.01	0.08**	0.02	0.04	-0.01	-0.03	1.00
(13) *Professor Founder*	0.04	0.12***	0.02	0.02	0.06	0.05	-0.11***	0.08**	0.26***	0.07*	0.04	-0.10**

Note. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table J.2. The Effect of University Stakes on VC Fundraising Amount

	Second-Stage IV Regressions DV: Log(Annual VC Fundraising Amount)			
	Unconditional on Fundraising Success		Conditional on Fundraising Success	
	(1) OLS	(2) IV	(3) OLS	(4) IV
University Stake	0.0149*	-0.1435**	0.0365	-0.0732
	(0.0086)	(0.0677)	(0.0263)	(0.1128)
Life Sciences	0.2202	1.0505**	-0.6682	0.7858
	(0.2561)	(0.5221)	(1.0971)	(1.9041)
Physical & Chemical Sciences	0.2081	1.2482**	-0.1543	0.7744
	(0.2514)	(0.5248)	(1.0923)	(1.4526)
London	-0.0523	-0.1572	-0.5150	-1.2586
	(0.4190)	(0.6339)	(1.1211)	(1.4271)
Number of Founders	0.0807	-0.1412	0.1444	-0.0351
	(0.0517)	(0.1166)	(0.2162)	(0.3078)
Entrepreneurial Experience	0.2365	-0.4145	0.4051	-0.0660
	(0.3203)	(0.4753)	(0.8874)	(1.0072)
Scientist-turned-Manager	0.3164	-0.1244	-0.4465	-0.9294
	(0.2406)	(0.4047)	(0.8082)	(0.9385)
Professor Founder	0.2047	0.8756*	0.3020	0.4631
	(0.2770)	(0.5155)	(0.9000)	(0.8578)
MBA Founder	0.5752	0.6297	1.3675	1.6134
	(0.5575)	(0.6556)	(1.2436)	(1.2535)
University Fixed Effects	Yes	Yes	Yes	Yes
Fundraising Year Fixed Effects	Yes	Yes	Yes	Yes
Number of Spin-outs	471	471	211	211
Observations	2427	2427	479	479
	First-Stage IV Regressions DV: University Stake			
Precedent University Stake		0.1885***		0.2807***
		(0.0637)		(0.0955)
F-statistic		8.77		8.64

Notes. This table reports pooled OLS and IV regressions on an unbalanced firm–year panel. The dependent variable is the natural logarithm of 1 plus the annual VC investment (in GBP), observed from the spin-out date until the first VC round or the end of the sample period. All regressions include an intercept. OLS and IV coefficients are reported, with standard errors in parentheses (clustered at the spin-out level). The sample excludes 178 spin-outs with missing precedent stakes. *University stake* is instrumented using the *Precedent University Stake* variable.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table J.3. The Effect of University Stakes on Fundraising from All Sources

	Second-Stage IV Regressions DV: Raised Equity			
	(1) OLS	(2) OLS	(3) IV	(4) IV
University Stake	-0.0002	0.0002	-0.0101**	-0.0121**
	(0.0006)	(0.0006)	(0.0042)	(0.0047)
Life Sciences		0.0205		0.0812**
		(0.0197)		(0.0387)
Physical & Chemical Sciences		-0.0095		0.0716*
		(0.0191)		(0.0395)
London		-0.0278		-0.0410
		(0.0312)		(0.0492)
Number of Founders		0.0333***		0.0091
		(0.0104)		(0.0212)
Entrepreneurial Experience		0.0124		-0.0553
		(0.0217)		(0.0375)
Scientist-turned-Manager		0.0461***		0.0094
		(0.0175)		(0.0316)
Professor Founder		0.0005		0.0450
		(0.0202)		(0.0371)
MBA Founder		0.0508		0.0490
		(0.0367)		(0.0473)
University Fixed Effects	Yes	Yes	Yes	Yes
Fundraising Year Fixed Effects	Yes	Yes	Yes	Yes
Number of Spin-outs	471	471	471	471
Observations	2427	2427	2427	2427
	First-Stage IV Regressions DV: University Stake			
Precedent University Stake			0.2113***	0.2095***
			(0.0653)	(0.0629)
F-statistic			10.46	11.08

Notes. This table reports pooled OLS and IV regressions on an unbalanced firm–year panel. The dependent variable equals one if the spin-out raised equity investment from any source in a given year after the spin-out event. All regressions include an intercept. OLS and IV coefficients are reported, with standard errors in parentheses (clustered at the spin-out level). The sample excludes 178 spin-outs with missing precedent stakes. For IV regressions, *University Stake* is instrumented using the *Precedent University Stake* variable.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

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