How does Equity Allocation in University Spinouts affect Fundraising Success? Evidence from the UK

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Abstract

There is considerable controversy about the allocation of equity in university spinouts. Founder teams and outside investors frequently criticize universities for taking excessive ownership stakes, weakening entrepreneurial incentives, and making spinouts unfundable. Universities in turn defend their ownership rights in terms of the resources needed to generate the research in the first place. This paper examines the impact of university ownership on subsequent fundraising success. The analysis is grounded in a theoretical model and uses detailed data from UK spinouts. Perhaps surprisingly, the data suggests a positive correlation between university stakes and fundraising success, even after controlling for observable characteristics. This correlation is partly driven by universities retaining larger stakes in their most promising spinouts. Using an instrumental variable based on the precedence set by prior spinouts within a university, we find some evidence that higher university stakes reduce the likelihood of fundraising success. A 10% larger university stake decreases the probability of raising venture capital on average by 3%. The negative effect is concentrated in less science-intensive spinouts (e.g., IT). However, the empirical analysis does not find significant negative effects for several other fundraising metrics, including investment amounts and valuations. Reductions in university stakes are followed by subsequent increases in universities' spinout rates.

Keywords: university spinout, equity allocation, fundraising

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Executive Summary

University spinouts, which combine entrepreneurship and innovative technologies, significantly contribute to economic growth. Yet there is considerable debate about how universities should foster the commercialization of innovations. In March 2023, the UK announced an independent review of the UK spinout landscape. One of the main concerns is that universities take overly large equity stakes in their spinouts, to the point of making them unfundable by private investors. Others argue that universities need to take appropriate stakes in order to recover costs and support the internal spinout process. While these issues have been debated for a long time, there is a surprising lack of objective data to inform the discussion.

In this paper we gather systematic data on a sample of 650 UK spinouts over the period 2010-2021. Our definition of a university spinout requires that a UK university owns at least 1% of the company's founding equity. The average university stake in our sample is 31%, trending down from 33% in 2010 to 24% by 2020. 66% of spinouts in the sample raise equity from some investors, 30% from venture capitalists. Only 5% of spinouts raise over £25M in total.

Our statistical analysis focuses on the relationships between university stakes and spinout fundraising. Perhaps surprisingly, we find a positive (and sometimes statistically significant) correlation between university stakes and several fundraising metrics, including the probability of raising venture capital, raising any equity funding, the amount raised, the post-money valuation, and the exit probability. Correlation does not imply causation because of selection effects. Specifically, universities may selectively retain higher stakes in their most promising ventures. To identify causal relationships, we use so-called instrumental variable regressions. We find that their estimated coefficients are typically smaller, often negative, which is consistent with the selection effect mentioned above. In our causal analysis, we find a negative significant relationship between higher university stakes and the probability of raising venture capital. A 10% decrease in the university stake leads to an estimated 3% increase in the probability of raising venture capital. However, this effect only applies to raising venture capital. We do not find any statistically significant effects on the broader probability of raising equity, the amount of funding raised, the valuations obtained, or the exit probability.

We further separate our data into two subsamples, one for more science-intensive sectors (involving industries based on engineering and biomedical sciences), and one for less science-intensive sectors (such as AI, IT, manufacturing, and others). We find that the negative causal effects of university stakes are stronger in the less science-intensive subsample.

We also examine the relationship between university stakes and spinout formation. We examine data about the total number of spinouts per university and ask whether a recent history of lower university stakes increases the number of spinouts. We estimate that 10% reduction in the (three-year trailing) average of university stakes leads to an 8% increase in the number of spinouts.

Overall, the results shed new light on the ongoing discussions about the role of university stakes in the spinout process. The debate often occurs in a data vacuum, this paper hopes to address that gap. Our findings do not support the claim that higher university stakes make spinouts unfundable, the evidence is much more nuanced. Simple regressions suggest a positive correlation between university stakes and fundraising outcomes, but one should not infer causality. Using an instrumental variable approach, we find a negative causal relationship between university stakes and the probability of raising venture capital. However, we do not find any significant effects for the probability of raising equity, the amount of funding, the post-money valuation, or the probability of exit. The negative effects are mainly in less science-intensive sectors. Finally, the evidence suggests that lower university stakes encourage spinout formation.

1 Introduction

A key challenge in the commercialization of science is the allocation of equity in university spinouts. Broadly speaking, there are two opposing views, often strongly held. The "university-friendly" view is that through their technology transfer offices (TTOs henceforth) universities are entitled to a 'reasonable' equity stake that pays for the resources expended in the creation of the spinout. The "founder-friendly" view, by contrast, questions the university's entitlement to any ownership and doubts the effectiveness of TTO services. Under this view, practically all the equity should go to the founding team.

This debate occurs in a fluid context where most universities are still relatively new to commercialization. TTOs continuously adapt to changing pressures from a variety of sometimes discordant stakeholders, including university leaders, academic scientists, venture investors, not to mention concerned policy makers. Passions can fly high in these debates, for example, when private investors complain that high university stakes make spinouts unfundable.[2] Yet there is surprisingly little data to objectively assess the merits of these alternative views.

This paper examines the relationship between the allocation of equity in university spinouts and their subsequent fundraising. The main research question is to assess the validity of the claim that higher university stakes make university spinouts less investable. To assess any causal relationship naturally requires disentangling treatment and selection effects. We also consider to what extent these effects differ by how science-intensive different spinouts are.

Because of its confidential nature, obtaining ownership data on university spinouts remains difficult in many countries, including the US. In the UK, however, the government requires public disclosure of ownership data for all private companies. We gather detailed data from a variety of sources on a sample of UK spinouts for the period 2010-2021. To isolate the initial allocation of spinout equity, we separate out the ownership of all early investors. We believe our sample has the most comprehensive and detailed data on UK university spinouts to date.

We develop a simple theoretical model that frames the empirical analysis around three main hypotheses. Figure 1 shows the time structure of the theoretical model, which also provides the basis for structuring the empirical analysis.

Insert Figure 1 about here

In the model there is a science stage where a scientist requires incentives to turn her scientific discovery into a spinout, and a commercial stage where either the scientist or a newly hired manager requires incentives for developing the business. The university, represented by its TTO, owns the IP and determines the equity ownership in the spinout. Its optimal allocation decision trades off the returns from higher ownership against the needs for incentives at both stages. The optimal university stake is shown to be a decreasing function of the incentive elasticities at both stages.

The model generates two main predictions to guide the empirical analysis. First, a higher university stake reduces the rate at which scientists convert their discoveries into spinouts. This is because of the need to provide spinout incentives at the science stage. Second, a higher university stake reduces the

[2] See Air Street Capital (2021) and Sifted (2022).

probability that a spinout succeeds in raising subsequent funding. This is because of the need to provide entrepreneurial incentives at the commercial stage.

A model extension generates a third theoretical prediction that underpins the empirical distinction between selection and treatment effect. In practice, TTOs have internal rules and guidelines that influence these allocation decisions, but there is always some discretion to negotiate. We therefore consider a simple negotiation game where the scientist always wants to negotiate a lower university stake. The TTO weighs when it is worth sticking to its policy, and when it is easier to make a concession. The key prediction from the theory is that if a TTO has lower return expectations, it is more willing to make a concession and reduce its equity stake. Consequently, the theory predicts that more promising ventures have higher university stakes.

For our empirical analysis, we focus on external fundraising as a first signal of the commercial viability of spinouts. This is also at the core of the public debates about whether high university stakes make spinouts unfundable. Our primary focus concern the probability of obtaining venture capital (VC henceforth). This is considered the hardest funding to get, and thus constitutes a strong signal of commercial progress. However, we also examine the probability of obtaining broader equity funding, the amounts raised, the post-money valuation, and the probability of a successful exit. Our first finding may be considered surprising. In simple regressions that control for standard observable characteristics (industry, location, university type, founder team characteristics, and calendar time), we consistently find positive correlations between university stakes and the various fundraising metrics. However, correlation does not imply causation.

We use an instrumental variable (IV) approach to disentangle selection and treatment effects. Our empirical identification is based on the negotiation dynamics between a spinout and its TTO. Specifically, we leverage the institutional reality that deals are typically negotiated on the basis of *precedence*. That is, once one founder team receives a better deal, it becomes harder for the TTO to refuse similar terms to the next team. We use the average precedent spinout stake in the same university as an instrument. We confirm its relevance in the first stage regression. The exclusion restriction holds because precedent stakes belong to other spinouts and therefore do not directly influence the fundraising of the focal spinout. In the second stage regressions we find that the IV lowers the coefficient of the university stake variable. This is consistent with the theory prediction that TTOs retain larger stakes in their most promising spinouts. In the IV regressions for the probability of obtaining VC, we find that the coefficient turns negative and significant coefficient. Quantitatively, a 10% increase in the stake held by the university reduces the probability of raising VC by 3% on average. For the other fundraising metrics, we similarly find that the IV reduces the university stake coefficient, consistent with our theoretical selection mechanism. However, the coefficient for university stake remains insignificant for these other metrics.

We also ask whether the effect of university stakes is heterogeneous in nature. In our sample, 57% of spinouts fall into a UK industry classification labelled "Professional, Scientific, and Technical." This category includes engineering and biomedical sciences. Spinouts in this category typically make substantial uses of university resources, including lab spaces and expensive equipment. We ask whether the impact of university stakes on fundraising differs for more versus less science-intensive spinouts. We find that the negative fundraising effects of university stakes are stronger for less science-intensive spinouts, a category that is dominated by digital and software innovations.

Finally, we examine the effect of university stakes on spinout formation. In a university-year panel regression we examine the effect of higher university stakes in the past on subsequent spinout formation. We find a positive effect, even after controlling for various time-varying university-specific correlates. On average, a 10% decrease in the university stakes is associated with an 8% increase in the spinout rate.

The paper closest to ours is Hvide and Jones (2018) who use a quasi-experimental setting leveraging the abolition of the "professor's privilege" (PP henceforth) in Norway. Before the abolition, academics owned their IP, but the abolition meant that two-thirds of the stake was transferred to their universities. The paper finds that the abolition of PP reduced the production of start-ups by university researchers by about 50%. Martínez and Sterzi (2021) summarize several more studies about similar PP abolitions in other European countries, showing that they tend to find similar results. A unique strength of these PP abolition studies is that they all have a quasi-natural experiment with a strong discontinuity. However, their study design cannot speak to what many practitioners and policy makers need to know, namely how marginal changes in university stakes affect spinout performance.

In related work, Asterbro et al., (2019) compare US and Swedish university spinouts. They note that the PP abolition studies focus on a relatively short window. The question whether the PP model actually generates different quantities and qualities of spinouts in the long run. Comparing detailed data from the US and Sweden (before its PP abolition), they do not find large differences in relative spinout rates between academic and non-academic founders. Interestingly, they also find that academic founders have significantly lower earnings in both countries. They thus question the desirability of policies that simply increase the number of spinouts without also improving their quality.[3]

Our theory paper builds on a prior theory literature about optimal contracts. Aghion and Tirole (1994) provide a general theory of innovation under incomplete contracts. Jensen and Thursby (2001) and Hellmann (2007) focus more specifically on incentives in technology transfer. Hvide and Jones (2018) also develop a theory model where both academic founders and university TTOs add value. They show that stakes should be allocated towards the agents whose investments have a greater effect on overall surplus. Interestingly, they themselves point out that the PP with a zero university stake can be suboptimal, because it discourages the commitment of university resources.

Building on these theories, a large empirical literature examines how scientists and universities respond to different commercialization incentives. Lach and Schankerman (2008), for example, examine the incentives of academics for patenting. Azoulay et al., (2009) consider the relationship between publishing and patenting. Debackere and Veuglers (2005) provide a useful discussion of the incentives and governance in technology transfer. The work of Avnimelech and Feldman (2015) identifies universities' academic quality and R&D budgets as important characteristics associated with high spinout rates. Tartari and Stern (2021) further find that US federal research funding plays a unique role in stimulating academic entrepreneurship. Furthermore, some authors question to what extent university TTOs help or hinder the success of technology transfer (see Thursby and Kemp, 2002 and Litan et al., 2007).

Our analysis is based on UK spinout companies. Useful reports on the UK spinout landscape can be found in Wright and Fu (2015), Hewitt-Dundas (2015), Ulrichsen (2019), and Beauhurst (2021).

[3] Åstebro et al. (2019) frame their comparison in terms of professor's privilege in Sweden (where universities have no stake) vs. versus Bayh-Dole act in the US (where universities get positive stakes). A separate and large literature compares the commercialization of innovation in the US before and after the Bayh-Dole act of 1980. This is a different policy change, because prior to the Bayh-Dole act, most of the university IP belonged neither to the university, nor to the professor, but to the federal government. The overwhelming conclusion from that literature is that the Bayh-Dole act played an important role in fostering university licensing and spinouts (see Mowery et al., 2001).

Ulrichsen, Roupakia, and Kelleher (2022) provide a detailed discussion of the process by which university stakes are determined. Of note, they call for more data-driven analysis, arguing that:

> *"Much has been claimed on these topics, but many claims appear to be justified largely on anecdotes and experiences with specific universities."*

Our analysis relies entirely on publicly and commercially available data, and therefore cannot comment on any of the licence terms that accompany university spinouts. Moreover, we do not have any systematic outcomes data beyond fundraising and exit, such as spinout's sales growth, employment growth, let alone investor returns. Our analysis only focuses on spinouts where the university holds a positive equity stake. It does not consider university-based startups (and so-called 'sneakouts') where the university holds no equity stake. Finally, we focus only on the UK and do not attempt to make any international comparisons.

This paper is structured as follows. Section 2 provides a theoretical framework, Section 3 provides an overview of the data sources and our methodology for computing university stake. Section 4 contains the main empirical results, and Section 5 concludes.

2 Theory

In this section we develop a theoretical framework to ground the empirical analysis. Specifically, we build a simple economic theory of the commercialization process that examines the incentive effects of ownership stakes. We derive equilibrium behaviours and establish optimal ownership stakes. The theory generates predictions as a basis for the empirical analysis. Our goal here is not to capture all the nuances of the commercialization process, but instead to lay out the broad relationship between ownership stakes and key commercialization metrics, especially the number of spinouts created and the (fundraising) success of these spinouts. The theory follows closely the logic of Figure 1 in the introduction.

There are three main players: (i) a scientist, denoted by S, who has a scientific discovery which has the potential for a spinout, (ii) a manager, denoted by M, who has the skills to manage a spinout, and (iii) the university, denoted by U, who owns the intellectual property and controls spinout formation. We assume that U's interests are represented by a commercially-minded technology transfer office that maximizes its ex-ante expected returns. All parties are risk-neutral and there is no time-discounting.

There are three dates. At date 0, S can spend time and effort to explore the commercial potential of her discovery. There is a university-internal development process where S's effort is required to turn the scientific discovery into a feasible spinout company. We denote S's cost of effort by e_S. With probability p a new spinout gets created at date 1. However, with probability $1 - p$ the development process fails, and no spinout is created. All utilities are normalized to 0 in that case. The probability p is increasing in S's effort e_S. We use a constant elasticity model where $p = p_0(e_S)^{\sigma}$. p_0 is a parameter that measures how promising the underlying discovery is. $\sigma \in (0,1)$ measures the importance of pre-spinout incentives, so we call it the spinout incentive elasticity.

We assume that after date 1, S does not have the skills to manage spinout herself (we will relax this assumption later). U hires M who needs to exert effort to make the spinout commercially successful. In light of our empirical context we assume that the first step towards success is raising VC. We denote M's effort costs by e_M. With probability $1 - r$ the spinout fails and has no value, so that utilities are zero. However, with probability r the spinout raises VC at date 2, attaining a value x. This can be interpreted as the pre-money valuation at the time of the funding round, thus measuring the equity value of all original shareholders (i.e., S, M, and U).[4] We use again a constant elasticity specification, namely $r = r_0(e_M)^{\rho}$. r_0 is a parameter that measures the spinout's prospects. We call $\rho \in (0,1)$ the fundraising incentive elasticity, measuring the importance of entrepreneurial incentives post spinout.

The financial value x is divided according to ownership stakes α_i, where $i = S, M, U$ and $\alpha_S + \alpha_M + \alpha_U = 1$. U controls this allocation decision. Let n be the (exogenous) number of scientific discoveries. U choses an ex-ante allocation that takes into consideration the effects of ownership on both the number of spinouts developed (np) as well as the probability of raising VC (r). Specifically, U maximizes its expected ex-ante return given by $nprx\alpha_U$. Higher values of α_U increase U's expected return for a given value of p and r. However, p and r are not fixed, because S and M adjust their effort intensity as a function of their ownership stakes.

In the Appendix we derive the optimal effort levels of S and M and derive how they influence the equilibrium values of p and r. The following two propositions provide the key predictions that form the basis for much of the empirical analysis.

Proposition 1: The number of spinouts, np, is an increasing function of the scientist's equity stake α_S. For a given manager stake α_M, an increase in the university stake α_U decreases the number of spinouts.

This proposition concerns the number of spinouts that emerge at date 1. It predicts a negative relationship between the number of spinouts and the ownership stake claimed by the university.

Proposition 2: The probability that a spinout raises VC, r, is an increasing function of the manager's ownership stake α_M. For a given scientist stake α_S, an increase in the university stake α_U decreases the probability of raising VC.

This proposition concerns the probability that a spinout succeeds raising VC at date 2. It predicts a negative relationship between the probability of raising VC and the ownership stake claimed by the university. This proposition thus formalizes the arguments discussed in the introduction about higher universities weakening entrepreneurial incentives and undermining VC fundraising.

Propositions 1 and 2 provide the key predictions for the empirical analysis. The next two Propositions explain U's optimal ownership choices.

Proposition 3: If the university controls ownership stakes, its optimal choices are given by

$$\alpha_M = \rho,\ \alpha_S = \sigma(1-\rho), \text{ and } \alpha_U = (1-\sigma)(1-\rho).$$

The university's optimal stake α_U is a decreasing function of the spinout incentive elasticity σ and the fundraising incentive elasticity ρ.

Proposition 3 establishes a simple and intuitive allocation rule. The more important are entrepreneurial incentives, as measured by ρ, the higher M's optimal ownership stake. This requires reductions in both S's and U's stake. Moreover, the more important pre-spinout commercialization incentives, as measured by σ, the bigger S's stake. This reduces U's (but not M's) ownership stake.

So far, we assumed that S does not have the skills to manage the spinout herself. In the Appendix we relax this assumption and rederive the model for the case where S transitions to become the spinout manager.

[4] Empirically we also consider other metrics to measure the commercial progress of the spinout.

Proposition 4: If the scientist transitions to become the manager of the spinout, then Proposition 1 and 2 continue to hold. The university's optimal stake continues to be $\alpha_U = (1-\sigma)(1-\rho)$, and the scientist receives the remainder, i.e., $\alpha_S = 1-(1-\sigma)(1-\rho)$.

This Proposition shows that the university's optimal ownership stake does not distinguish between the case where the scientist remains in the university versus transitions to become an entrepreneur.

Finally, we extend our theory to provide a conceptual foundation for the selection effects that play an important role in the empirical analysis. We ask whether universities always want to strike the same deal across different types of spinouts? Put differently, are universities equally likely to insist on taking a high stake in spinouts with better or worse return prospects? To address this we introduce a simple 'reduced-form' bargaining game that captures typical dynamics in university negotiations.

Assume that U has a default policy of taking the optimal stake as derived in Proposition 3 and 4. However, S (possibly working with M) always has an interest to negotiate down the university stake. In practice universities sometimes find it difficult to apply their default policies. We model this as a cost c with some distribution $\Omega(c)$. Instead of incurring this cost, U can simplify things by making a concession. In our model this consists of forgoing an equity stake δ. Such a concession would typically be based on university precedent, so that the size of δ is based on what deals were previously done in the university. In the Appendix we show that there exists a critical value c^* so that U sticks to its default policy (with a higher university stake) whenever $c < c^*$. However, U makes a concession δ and takes a lower university stake whenever $c > c^*$. The probability of a high university stake is thus given by $\Omega(c^*)$. In the Appendix we show that c^* is an increasing function of the venture's commercial opportunity, as represented by x. This generates the following Proposition.

Proposition 5: The probability $\Omega(c^*)$ that the university sticks to its default policy is increasing in x. Thus, higher university stakes are relatively more frequent among spinouts with greater commercial potential.

3 Data and Variables

This section discusses the hand-collected dataset of UK spinouts founded between 2010 and 2021. The dataset includes ownership tables, stakeholder classifications, stakeholder characteristics, and financial performance measures. Utilizing data from the UK university spinouts identified by the UK startup data aggregator Beauhurst, we have compiled a robust dataset of 650 spinouts that aims to fill an important gap in the debate about university stakes for spinouts.

3.1 Data Sources

This project involves an extensive data collection effort about UK spinouts founded in the decade starting in 2010, including data on ownership tables, stakeholder classifications, stakeholder characteristics, and financial performance measures.

For our analysis, we rely on the UK university spinouts identified by the UK startup data aggregator Beauhurst.[5] Their definition of a spinout aligns with Higher Education Statistics Agency's (HESA, 2023): A university spinout is any company that was created to use intellectual property developed by a recognized UK university. Their dataset uses administrative data from the UK company registry

[5] Beauhurst (2021) defines a university spinout company as one that adheres to the HESA definition and meets at least one of the following criteria: the university possesses intellectual property (IP) which it has licensed to the company; the university holds shares in the company; or the university has the option, through an options or warrants contract, to acquire shares in the company at a future date.

called Companies House, making the data more accurate and comprehensive as compared to commercial databases such as Crunchbase or Pitchbook. Ulrichsen (2019) provides further discussion on the completeness of Beauhurst's sample of spinouts. Beauhurst identifies a total of 1,103 spinouts incorporated between 2010 and 2021 and provides rich data on spinout characteristics such as industry classification and fundraising data, including deal-level data on the funding amounts. We apply objective filtering criteria to this initial sample to obtain a final sample consisting of 650 spinouts. Appendix 2 provides a description of the filtering used.

We use Companies House administrative records to extract the equity distribution between the university and the founding team. From Companies House, we collect all annual capitalization tables. There are two documents in Companies House that contain capitalization tables: The Certificate of Incorporation and Confirmation Statements. The Certificate of Incorporation is filed when the company is set up and contains the capitalization table at incorporation. Confirmation Statements are filed annually and contain the updated capitalization table with any additional shareholders (e.g., investors).

Since the legal entity in Companies House is not always set-up at the time when the spinout deal between the university and the founding team is finalized, the Certificate of Incorporation does not necessarily reflect the equity split resulting from this deal. In fact, there are often cases when the capitalization table at incorporation contains only the university or only the founders, with subsequent capitalization tables containing both. In order to compute the equity stakes held by the university and the founding team, we rely on the earliest cap table which contains both (henceforth referred to as the 'relevant cap table'). The underlying assumption is that the ownership stake which the university holds at the spinout event is reflected in the capitalization table of the next immediate Confirmation Statement/Annual Return to be filed. We make this assumption as the actual spinout date is not publicly available, as discussed in the next section.

3.2 Inferring the Spinout Date

Our analysis of the performance of the company after the spinout event requires information on the date the company spun out. As this date is not publicly available, we infer it by relying on the dates of two frequently filed documents: SH forms and Articles of Association. To track the changes in the share capital, UK companies are legally required to file SH forms typically within one month since the change occurred (Companies House, 2021). A second useful document is the Articles of Association (AoA). Universities usually encourage spinouts to file AoA at the spinout event, so that the rights and responsibilities of shareholders are clearly spelled-out (e.g., see OUI, 2021). The detailed methodology of inferring the spinout date is given in the Appendix 3.

The spinout date is ambiguous when multiple SH forms are filed. To minimize error, we also consider information on the type of investors involved in each round. We assume that private investors would not invest in the spinout before the equity distribution deal between the spinout and the university is finalized. Hence, the spinout date is taken to be the minimum between our inferred spinout date and the date of the earliest round where any investor other than the government, university or non-for-profit organizations participated.[6]

3.3 Institutional Arrangements

[6] The government, university, or charities may invest before the equity allocation between the university and the founding team is finalized so as to support the creation of the spinout.

There can be complexity to the structure of some TTOs, because some UK universities outsource their commercialization services to external organizations.[7] As part of the arrangements, universities may fully or partially transfer equity stakes to these outside organizations. We define these vehicles as university-affiliated funds. Appendix 4 lists the summary of the deals between the universities and university-affiliated funds over our sample period.

Scientists could sometimes be jointly affiliated with the university as well as outside research agencies. A notable example is medical scientists being affiliated at NHS trusts. In this case, both the university and external research agencies can claim IP rights to the invention. We define these agencies as 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 such funds and trusts the same as those of universities and adds the equity stake held by them to the equity stake held by the university.

3.4 Shareholder Categorization

Being equipped with the capitalization table reflecting the equity allocation deal at the spinouts event, the spinout date, and our understating of the commercialization process, we next turn to identify involved parties who are allocated an equity stake.

Using the information on several sources such as Articles of Association, spinout website, LinkedIn, departmental websites, as well as other publicly available information, we classify each person and entity in the relevant capitalization table into one of the following categories: university, university-affiliated fund, trust, scientist, manager, and investor. Any shareholder for which we could not find any information is categorized as an unknown.

Appendix 5 provides a description of how the judgement calls on shareholder classifications were made. For our analysis, the spinout founding team is comprised of scientists and managers.[8] Several variables are collected for members of the founding team, including gender, highest education level completed, field of study, prior entrepreneurial experience, affiliation with the academic institution, and position held within the spinout.[9]

3.5 Computation of University Stake

Our research question focuses on the equity allocation between the founding team and the university at the spinout event, which in turn reflects the allocation of IP rights between the two sides. As such, when calculating the university stake, we exclude any investment made by external investors, the university, university-affiliated funds or the founding team. This is done to avoid any spurious correlation between the university stake and fundraising outcomes. Appendix 6 includes examples to illustrate this point. We thus distinguish between 'paid' shares obtained on the basis of making an investment, and 'free' shares obtained on the basis of owning the IP. We define the University IP Stake as the % of the free shares held jointly by the university, university-affiliated funds and trusts, relative to the total free shares held by the former as well as the founding team.

[7] Notable examples include Imperial College London fully outsourcing its services to Touchstone Innovations, and multiple other universities partially outsourcing commercialization to investment vehicles (RSM, 2018; HEBCI, 2022).

[8] We also include here any advisors who join at the spinout event, though the equity stakes of the latter are negligible.

[9] Currently, we have only gathered the variables on founder backgrounds only for a subset of the founding team. Our data collection process is still ongoing, and we plan to gather variables for all members of the founding team.

We utilize SH01 forms, which are filed whenever new shares are allotted, to identify the price of issued shares.[10] Although SH01 forms provide the price per share issued, they do not provide the identity of the shareholders holding them. In many cases, it is possible to infer the identity of the shareholder by using the class of shares held by him/her in the capitalization table, or by matching his/her holdings in the capitalization table to the block structure in which shares are issued in SH01 forms. However, there can also be more complicated cases when SH01 forms do not have enough information needed to infer the price per share for different shareholders. Interviews with practitioners suggest that the founding team is very unlikely to invest, compared to the university. We hence assume that the founding team has priority in receiving the lowest priced shares followed by the university, university-affiliated funds, and lastly investors.

We define free shares as shares with a price per share equal to the lowest priced shares held by the founding team. We use the lowest founder share price as opposed to the university lowest share price because it could be that university has received no IP stake and has solely made an investment into the spinout. Letting University IP Shares denote the free shares held jointly by the university, university-affiliated funds and trusts, the formula for the university IP stake is thus given by:

$$University\ IP\ Stake = \frac{University\ IP\ Shares}{(University\ IP\ Shares + Free\ Founding\ Team\ Shares)} * 100$$

Appendix 7 has a detailed explanation of our methodology. From here on, we use the term University stake and University IP stake interchangeably.[11]

3.6 Variable Definitions

Table 1 provides the definitions of the dependent variables we use in our main analysis, alongside the control variables.

Insert Table 1 about here

We consider the following spinout performance measures: whether a spinout raised VC, whether it raised any equity investment, the amount raised (conditional on fundraising success), the earliest post-money valuation received, and whether the spinout had a successful exit (defined as either being acquired, or achieving an Initial Public Offering).[12]

The key independent variable of interest is the University IP Stake, computed according to the methodology outlined in Section 3.5. Next, we construct several controls describing characteristics of the founding team. Building on the literature which explores how founders' prior work experience shapes early business strategies (see Beckman et al. 2007), we control for managers' prior entrepreneurial experience and prior work experience. We summarize the former into a dummy variable about whether any of the manager founders has prior entrepreneurial experience; for the

[10] Companies in the UK are legally required to file SH01 forms within one month following the allotment of new shares (Companies House, 2021).

[11] Given that we are only considering the equity deal reflected in the relevant capitalization table, the present analysis cannot speak about how the university and founder stake is diluted with subsequent investments. In particular, we abstract from considerations of anti-dilution provisions.

[12] We rely on Crunchbase to get exit data up to June 2023. We merge Crunchbase data on exits to our sample based on the name of the spinout and the region it is located in (England, Wales, Scotland, Ireland). For any spinout not covered by Crunchbase, we do a keyword search on the internet, using the phrases 'acquired' and 'ipo'. We use the same search method to settle any contradictions between Beauhurst and Crunchbase.

latter, we use founders' average number of years of work experience. To gauge the business background of the manager founders, we specify a dummy about whether any of them holds an MBA. We also control for founding team size, as prior studies show it is correlated with fundraising outcomes (e.g., Hellmann and Wasserman, 2017). We also consider the research quality of the scientist founders. We proxy this by the nature of the academic affiliation of the scientist founders. The dummy variable we define captures whether any of the scientist founders held a professorship during the year preceding the spinout event.[13]

The next group of controls are spinout characteristics. Given the limited number of observations, we group the industry and region into broader categories defined in Table 1. The universities are grouped into three categories: Oxbridge, Russell Group and Non-Russell Group. We also include spinout year dummies, to account for potential UK-wide factors affecting the particular spinouts and universities as well as the general entrepreneurial climate in those years. Finally, we include dummies for the age of the spinout (in years) at the period during which we study its fundraising outcomes.

3.7 Summary Statistics

Table 2 provides summary statistics at the cross-section. Table 3 reports pairwise correlations. Our sample consists of 650 spinouts, although 22 spinouts have missing values for the average work experience of founders and are thus excluded from the regression analysis. There is considerable variation in the university stake in our sample, ranging from 1.3% to 76.4%, with an average stake of 31%. This reflects the variation in the institutional design of IP policy across universities, but also over time. Our data reveals that 66% of the spinouts raised funding. The proportion drops to 30% when considering VC. Moreover, 8% of the spinouts in our sample had a successful exit.

Insert Tables 2&3 about here

In order to better understand the correlation between equity allocation and spinout characteristics, Table 4 reports results from an OLS regression at the cross-section. A higher founding team size is correlated with lower university stake. This suggests that bigger teams may be better able to negotiate in their favour.

Insert Table 4 about here

The presence of a founder who holds a Professorship, or an MBA, is positively correlated with the university stake. One potential explanation is that the TTO may view these characteristics as a signal of good future performance, and hence may extract higher equity stakes in what it expects to be more promising ventures.

Finally, Russell Group universities extract higher university stakes compared to both Oxbridge and Non-Russell Group.

[13] Here we include Assistant, Associate as well as Full Professors.

4 Empirical regression analysis

This section discusses our empirical findings about the relationship between university stakes and the fundraising success of spinouts.

4.1 Simple OLS regression analysis

To assess the determinants of the probability of fundraising, we begin by estimating a pooled OLS regression which does not address endogeneity concerns. We use linear regression models throughout because they can address both uninstrumented and instrumented regressions consistently.[14] For each one-year period after the spinout event, we specify a dummy for fundraising success equal to 1 if the spinout raised funding for the first time in that year. Once a spinout raises funding in a given one-year period, it is excluded from the sample for the subsequent years since we are interested in the probability of the first fundraising success. Standard errors are clustered at the spinout level to allow for the correlation of yearly observations within a spinout. The controls include industry and university groups, spinout cohort, and age fixed effects. Please refer to Table 1 for more details on our independent variables. The results are shown in the first and third columns of Table 5.

Insert Table 5 about here

The coefficient for the university stake is positive, and significant at 5% for equity fundraising. This may be considered slightly surprising, given the widely held belief that higher stakes hinder fundraising. This regression coefficient, however, is consistent with the univariate tests shown in Table 2, which shows that, among spinouts with above-median university stakes, 71% raised equity and 32% raised VC, compared to 62% and 28% for spinouts with below-median university stakes. The coefficients in columns (1) and (3) measure the (conditional) correlation between university stakes and the probability of raising funds, but do not imply a causal relationship. For that reason, we now develop our instrumental variable approach.

4.2 Instrumental variable estimation

In the above specification, the university stake could be endogenous. Of particular concern is the possibility that the university negotiates different stakes depending on its expectation of how well the spinout will perform in the future. Proposition 5 predicts a higher university stake for more promising ventures. Such a selection effect bias the OLS coefficients upwards.

In our context we do not have the benefit of a discontinuous policy shock, such as the abolition of the PP. Also, our analysis does not focus on the presence or absence of university stakes but focuses instead on the level of university stakes, the issue that has preoccupies much of the practical debates. We propose an instrumental variable that reflects exogenous changes in the university's bargaining position. Specifically, we measure the 'precedent stakes' that founder teams can invoke as part of their negotiations. Recall that TTOs negotiate university stakes within a set of rules and guidelines that leave some discretion. In reaching an agreement, both universities and founders can invoke examples of what happened before to justify their bargaining positions. Put differently, we would expect the university to offer similar deals to comparable prior spinoffs. This justifies the relevance condition for a first-stage regression. For the second-stage regression, the exclusion restriction holds because precedent deals concern other spinoffs and therefore do not directly affect the performance of

[14] In section 4.6 we report further robustness checks related to this.

the focal firm.[15] Concretely, our instrument, called "Precedent University Stake," is a 3-year moving average of the university stakes from spinouts in the same university that preceded the focal spinout.[16]

Let us briefly dwell on the source of variation for our instrument. Figure 2 shows that the average university stake fell from 33% in 2010 to 24% in 2020. This is consistent with the notion that over time, lower precedent stakes exert pressure on university TTO to accept even lower stakes.

Insert Figure 2 about here

However, this by itself is not the source of variation, instead what matters is how university stakes vary over time *within* different universities. The central idea is that some spinouts may be luckier than others because they were preceded by other spinouts that already lowered the average stake within their own university. To illustrate this, Figure 3 shows how university stakes evolve over time in different universities. The Figure reveals considerable variation across universities, with numerous switches of being above or below the overall UK trend line.

Insert Figure 3 about here

We thus estimate a 2SLS regression for the probability of raising VC, using Precedent Uni Stake as an instrument in the first stage regression. Column (2) of Table 5 reports the results. The instrument itself is highly significant at the 1% level, with a large F-statistic of 53. Turning to the second-stage regression we find that the coefficient in column (2) is smaller than in column (1). Importantly, it turns from being positive and insignificant in column (1) to being negative and significant in column (2). This is consistent with the Proposition 5 that predicts a positive selection effect. This creates upward bias in the OLS coefficient. The results from the 2SLS regressions are also consistent with Proposition 2 which predicts a negative effect of university stakes on the probability of raising VC.

To give an idea of the economic magnitudes, column (2) suggested that, evaluated at the mean, a 1% point increase in Uni Stake decreases the probability of raising VC by 0.3%. Since the probability of raising VC in the overall sample is 30%, a 10% point decrease in the university stake would take that up to 33%.

[15] Our instrument is based on peer effects where the ownership of the focal spinout is affected by the deals received by peers, most specially spinouts in the same university that came before the focal on. Research on peer effects dates back to Sacerdote (2001). Ahern et al. (2011) use peer effects to study risk versions, and Lerner and Malmedier (2013) examine peer effects among entrepreneurial MBA students. Our identification logic is thus related to instruments that leverage local peer effects. Along similar lines, Berger et al. (2005) use variation in local banking markets to control for endogenous matching of firms with banks. In the venture capital literature, Bottazzi et al. (2008) and Chemmanur et al. (2011) also use similar instruments based on the local funding availability. Throughout this literature the relevance condition comes from local peers influencing the transaction of the focal actors. The exclusion restriction requires that the only way peers influence the focal actor is through the transaction, but they do not influence the focal spinout's performance directly. In our context, the precent university stakes influence the stake in the focal spinout, but they do not directly affect the performance of the focal spinout.

[16] If a company spun out from two universities, we assign it to the university holding the highest equity stake for the purpose of constructing the instrument. When the universities hold equal stake, we assign the spinout to the university which has had the highest spinout activity in our sample, as measured by the number of spinouts it has produced. The rationale for doing so is that the university with the highest stake or activity would presumably have the highest bargaining power and hence it is the precedence from this university which would be most predictive of the equity stake taken in the focal spinout. For spinouts formed before 2013, the window of constructing the precedent stake is smaller than three years since our sample begins in 2010.

The results in column (3) and (4) pertain to the broader measure of raising any equity. The overall pattern of results is very similar. Column (3) actually suggests a positive and significant coefficient. Again we find that the use of an instrument corrects for the selection effect and its upward bias. In column (4) the coefficient equals exactly zero, and thus insignificant.

4.3 Sectoral differences

The negative coefficient in column (2) of Table 5 is of central interest and deserves further analysis. We therefore focus on the distinction between more and less science-intensive spinouts. Table 2 shows that 57% of spinouts fall into the "Professional, Scientific, and Technical" industry classification which includes engineering and biomedical sciences. Universities spend considerably more resources on these spinouts which make substantial uses of university resources, including lab spaces and expensive equipment. One may thus ask whether the role of university stakes pays out differently in more vs. less science-intensive spinouts. Table 6 reports the results of running the regression in the two subsamples. Looking first at the un-instrumented regressions, the coefficients are positive and significant for the more science-intensive spinouts but remain insignificant for the less science-intensive ones. In the instrumented 2SLS regressions, we notice once again smaller coefficients. For the less science-intensive spinouts the coefficient in column (4) is -0.0045 and statistically significant. Thus, on average, a 10% point increase in the university stake decreases the probability of raising VC by 4.5.%. For the more science-intensive spinouts the coefficient in column (2) is -0.0022 and marginally insignificant (p-value of 0.13).

Insert Table 6 bout here

Overall, these results suggest that university stakes can have different effects on different spinouts. The problem of high university stakes making companies less fundable seems to be more salient in less science-intensive sectors, such as IT, but less so in the more science-intensive sectors, such as engineering or biomedical.

4.4 Additional spinout performance metrics.

So far, our analysis focuses on the probability of raising VC and broader equity. In Table 7 we consider the effect on other fundraising and performance metrics. Panel A reports the OLS regressions and Panel B the 2SLS regressions. In columns (1) the dependent variable is the natural logarithm of the annual VC amount raised each year after the spinout event, conditional on the amount being positive.[17] Column (2) replaces VC amounts with all equity amounts. We find that the estimated coefficients are positive in the OLS regression of Panel A. Panel B corrects for the upward bias and finds that the coefficients are statistically insignificant.[18]

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[17] Spinout-year observations are dropped if spinout age does not cover the entire period specified so that we do not underestimate the actual amount raised. For the same purpose, we also drop spinout-year observations, where the amount was undisclosed for any of the deals falling in a particular year. This problem is only limited to about 3.6% of the deals in our sample.

[18] In unreported regressions, we also verified that the panel results for annual amounts also carry over to cross-sectional regressions with cumulative amounts.

Insert Table 7 about here

The next performance metric we consider is the post-money valuation. We estimate cross-sectional OLS and 2SLS regressions where the dependent variable is the natural logarithm of the earliest available post-money valuation.[19] Column (3) in Table 7 reports the results. The coefficient of Uni Stake is insignificant for both OLS and 2SLS specifications.[20]

Finally, we ask whether the university stake affects eventual spinout outcomes, measured by whether the spinout was acquired or achieved an Initial Public Offering. For each one-year period after the spinout event, we specify a dummy for exit success equal to 1 if the spinout had a successful exit in that year and has been operating for the entire period. Once a spinout exits in a given one-year period, it is excluded from the sample for the subsequent years. Standard errors are clustered at the spinout level to allow for the correlation of yearly observations within a spinout. Column (4) in Table 7 reports the results. The coefficient of Uni Stake is statistically insignificant for both OLS and 2SLS specifications.

4.5 The effects of university stakes on spinout formation

So far, we have focused on the fundraising performance of spinouts which have already been formed. We next ask whether the university stake has an effect on the number of spinouts formed. Specifically, we aim to empirically test Proposition 1 from the theory in Section 2.

We construct a panel where the dependent variable is the natural logarithm of 1 + the number of spinouts with positive university ownership, formed in each university at each academic year in our sample.[21] The main independent variable of interest is the average equity stake that the university has taken from its spinouts over the previous three academic years, excluding the year under consideration.

We also control for various time-varying characteristics provided by the annual HEBCI survey. Each year, universities across the UK are legally required to report answers to the survey, which cover a broad range of services the university offers, as well as performance indicators for the startups and spinouts it produces (HEBCI, 2022). The first group of controls captures the inflow of innovation into university's TTO: the number of scientific disclosures and number of patent applications. Secondly, we proxy the resources the TTO invests towards the exploitation of IP by controlling for the annual IP Expenditure. The third group of controls aims to capture the overall entrepreneurial climate at each university: the number of staff startups (not spinouts) and external investment received by previous spinouts.

All controls are specified as the average university characteristics over the previous three academic years, excluding the year under consideration. Panels B of Table 1, 2 and 3 provide variable definitions, summary statistics, and pairwise correlations, respectively. Table 8 shows regression results.

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[19] If a round has missing valuations, the next available valuation is used. Using latest, as opposed to earliest valuation gives similar results qualitatively, so we only report regressions on the determinants of earliest post-money valuation.

[20] Since the dependent variable is the natural logarithm of the earliest post-money valuation and Uni Stake is measured in units from 1-100, the marginal effect is calculated as (Exponential (Uni Stake coefficient)-1)*100%. In the 2SLS specification, the size of the coefficient suggests that a 1% point increase in Uni Stake reduces the earliest post-money valuation by 0.6%, but the effect remains statistically insignificant.

[21] As reported by HEBCI.

Insert Table 8 about here

The coefficient of Precedent Uni Stake is negative and significant across all specifications. Quantitatively, a 1% increase in Uni Stake decreases the number of university-owned spinouts by 0.8%. This confirms the theory predictions from Proposition 1 that higher university stakes have an effect on the extensive margin in terms of reducing the number of spinouts.

4.6 Robustness

As a first robustness check, we consider potential threats to the validity of the 'precedent stakes' instrument. The exclusion restriction would fail if there was unobserved correlation between the instrument and the prospects of the focal venture. One possible channel through which this could happen is the evolution of the local entrepreneurial climate of universities over time. Lowering the equity stakes in the preceding ventures may be correlated with improved quality of the current venture due to other aspects of the entrepreneurial climate becoming friendlier, enabling the university to produce better spinouts. As an example, the university may be able to build a stronger network with investors after lowering its equity stakes in spinouts. Another channel is the improvement of the commercial potential of the university research, which may impact the quality of entrepreneurial-minded researchers the university attracts in the future. To address these concerns, we include the time-varying university characteristics, already described in Section 4.5, to our main regression on the determinants of VC fundraising success. Table 9 summarizes the results for the determinants of VC fundraising success. The Uni Stake coefficient remains stable across all different specifications.

Insert Table 9 about here

Next, we check whether our results are sensitive to the definition of sectors. The current definition only consists of four categories, where we have grouped multiple SIC groups in the last category. We consider an alternative sectoral definition, similar to Hvide and Jones (2018), using fixed effects for each SIC group.[22] Table 10 reports the results for the probability of VC fundraising success. Both the size as well as the statistical significance of the Uni Stake coefficient remains intact.

Insert Table 10 about here

As a further robustness check, we replace the linear probability model with Probit and IV-Probit regressions for the probability of fundraising success, using the same Instrumental Variable as before. Table 11 depicts the results. Qualitatively, the effect on Uni Stake remains the same: Uni Stake has a negative effect on VC fundraising success, and the effect is stronger in less science-intensive spinouts. In terms of the size of the effect, the IV Probit predicts a 0.33% decrease in the probability of VC funding for the overall sample (as opposed to 0.3% with linear model) and a 0.61% decrease in probability of VC funding for the less science-intensive sample (compared to 0.45% in linear models)

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[22] Hvide and Jones (2018) determine sectors using the 1-digit NACE code in their main analysis (see Table 2 for e.g.). Similar to us, they make this choice as opposed to using more granular industry controls because they are constrained by the number of observations.

for a 1% point increase in University Stakes.[23] Hence the results remain similar both qualitatively and quantitatively.

Insert Table 11 about here

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5 Conclusion

In this paper, we examine how the allocation of ownership in university spinouts affects their ability to raise subsequent funding from outside investors. Simple correlations suggest a positive relationship between university stakes and fundraising metrics. This may be partly driven by selection effects where universities retain larger stakes in their most promising ventures. Using an instrument based on precedent stakes, we find some evidence of a negative causal relationship between the university stake and the probability of raising VC. This negative impact is concentrated in less science-intensive spinout sectors.

The analysis provides new insights into the role of equity allocation on spinout performance and raises further questions for future research. A typical spinout involves a complex contract that specifies not only the allocation of equity, but also several other terms, most notably licensing terms. This data is not publicly available and would thus require access to confidential data. This would allow an examination of the relationships between licensing terms and spinout performance, and how this might interact with the ownership channel discussed here. Beyond looking at fundraising success, it would be valuable to consider additional performance metrics, such as sales growth, employment creation, and eventually exit values and investment returns.

[23] This is the average marginal effect of Uni Stake on probability of VC funding.

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Figure 1: The spinout process from the science to the commercial stage

This figure shows the time structure of the theoretical model, which also provides the basis for structuring the empirical analysis.

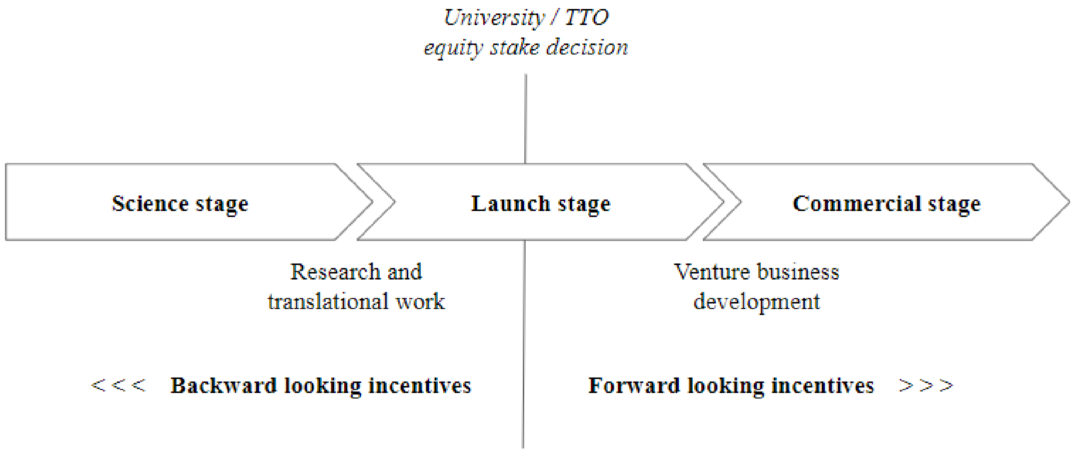

Figure 2: University stakes over time from 2010 to 2021, sample mean is 31%

This figure shows the annual mean in university equity stakes across universities for our sample of 650 spinouts.

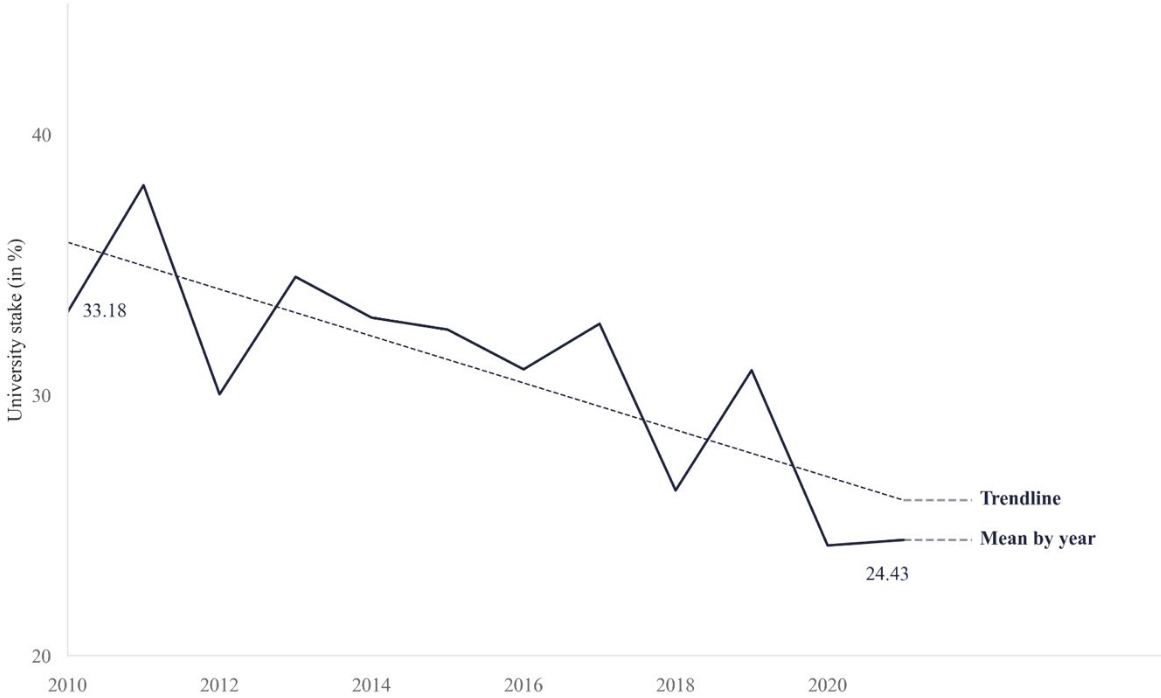

Figure 3: Evolution of university stakes within different universities

This figure depicts the evolution of equity stakes within different universities over time (blue line), comparing it to the annual average university stake across universities (red line). Blue (red) regions mean that within university stakes were higher (lower) than the UK average for the particular year.

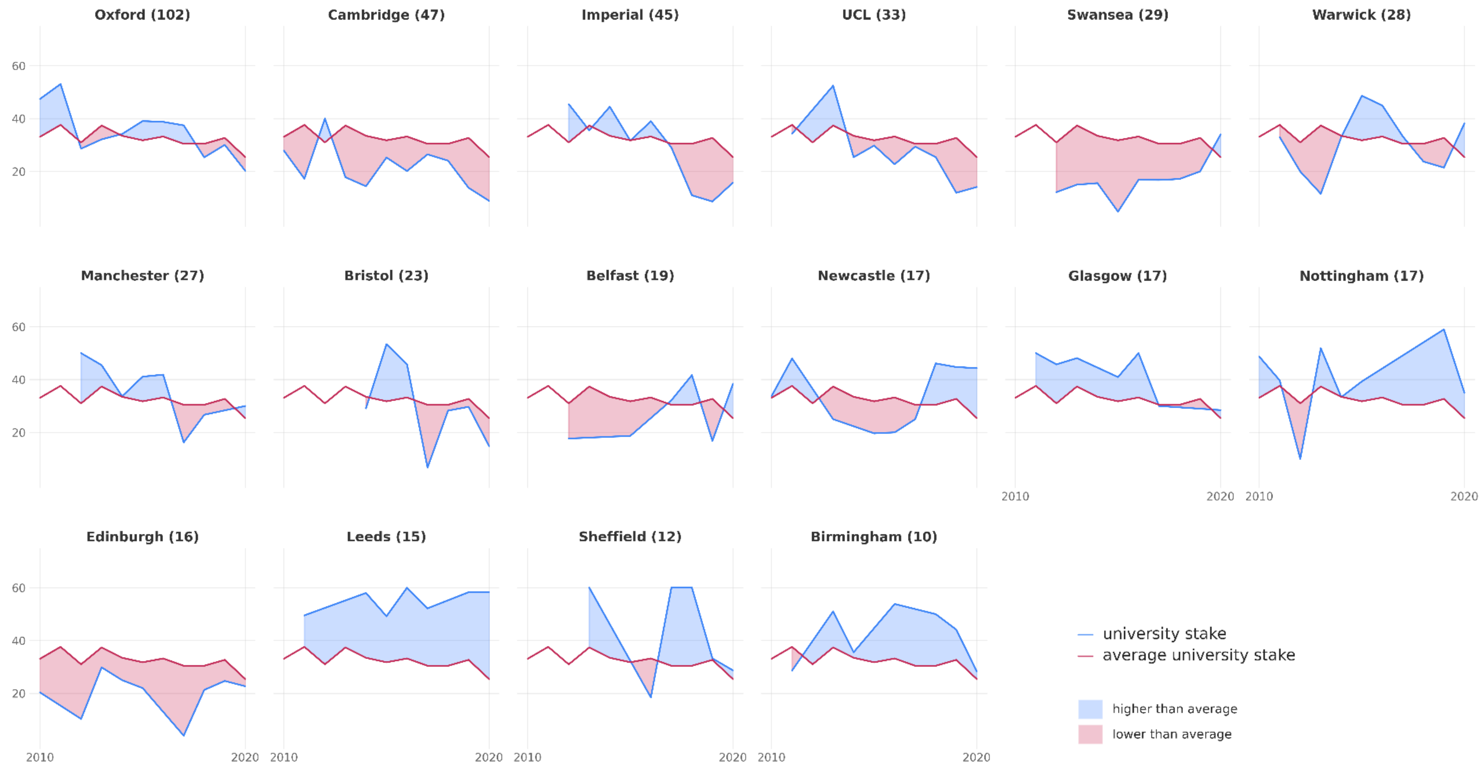

Table 1: Variable definitions

This table provides definitions for the variables used in our main analysis. Panel A defines variables at the spinout level and panel B defines variables at the university level.

Panel A: Variables defined at the spinout level

Dependent Variables	
(1) Raised VC	Dummy variable equals 1 if the spinout received VC investment each year after spinout event.
(2) Annual VC Inv	Annual amount raised in million GBPs from rounds where VC participated over each one-year period after the spinout event, conditional on the spinout having raised VC funding.
(3) Raised Eq	Dummy variable for spinouts that raised equity investment each year after the spinout event.
(4) Annual Eq Inv	Annual amount raised in million GBPs over each one-year period after the spinout event, conditional on the spinout having raised equity funding.
(5) Post-money Val	Earliest available post-money valuation in million GBPs for a spinout.
(6) Exit	Dummy variable for spinouts which were acquired or received an Initial Public Offering.
Independent Variables	
(7) University Stake	University equity stake at the time of spinout, measured in units from 0-100.
(8) Precedent Uni Stake	Average university stake of companies spun out from the same university in the three-year period prior to the spinout event of the focal company.
(9) Nr of Founders	The total number of scientists, managers and advisors.
(10) MBA	Dummy variable equals to 1 if any of the spinout managers has an MBA.
(11) Entre Exp	Dummy variable equals 1 if any of the managers has prior entrepreneurial experience.
(12) Avg. Work Exp	Average work experience (in years) of founders.
(13) Prof Scientist	Dummy variable equals 1 if any scientist founder was a professor before the spinout event.
Fixed effect variables	
Industries	Dummy variables for Manufacturing (SIC Group C), IT (SIC J), Scientific (SIC M), and Other industries.
Regions	Dummy variables for London, Northern Ireland, the Rest of England, Scotland, and Wales.
Spinout Age	Dummy variables for the age of the spinout in years.
Spinout Cohort	Dummy variables for the year in which the company spun out of the university.
University Groups	Dummy variables for the membership of the focal university belonging to Oxbridge, Russell Group Universities, and the Non-Russell Group Universities.

Panel B: Variables defined at the university level

Dependent Variables	
(1) Nr. university-owned spinouts	Number of spinouts created in each academic year by each university, where the university holds some ownership.
Independent Variables	
(2) Precedent Uni Stake	Average equity stake that the university has taken from its spinouts over the previous three academic years, excluding the year under consideration.
(3) Nr of disclosures	Cumulative total of disclosures for the academic year.
(4) Nr Patent Apps	All Patent Co-operation Treaty (PCT) applications filed in an academic year.
(5) IP Expenditure	Cost of IP Expenditure (000s GBP), such as salary and related costs of IP staff, patent and other protection fees and legal expenses.
(6) External Inv	Estimated external investment received (000s GBP) by university-owned spinouts from external partners.
(7) Startup Nr	Number of companies set-up in each academic year by ective or recent academic staff in the university, but which are not based on IP from the instituion.
Fixed Effect Variables	
Academic year	Dummy variable for each academic year.
University	Dummy veriable for each university.

Table 2: Summary Statistics

Table shows summary statistics for overall sample, High Uni Stake and Low Uni Stake subsamples. Subsamples: relative to median university stake. For Panel A, variables (1) and (3): dummy for spinout funding type raised over lifetime; (2) and (4): average raised amount over lifetime in Million GBPs, conditional on success. Variable (5) is defined as the earliest available post-money valuation (if a round has a missing valuation, the next available valuation is used). Two-sided Welch test conducted for mean equality across subsamples. Significance: ***, **, * for 99%, 95%, 90% confidence levels.

Panel A: Variables defined at the spinout level

	Full Sample			High Uni Stake	Low Uni Stake
	Obs.	Mean	St.dev.	Mean	
(1) Raised VC	650	0.3015	0.4593	0.3211	0.2817
(2) Annual VC Inv	189	2.3886	5.1430	2.9395*	1.7562
(3) Raised Eq	650	0.6646	0.4725	0.7064**	0.6223
(4) Annual Eq Inv	419	1.9012	4.6933	2.2009	1.5569
(5) Post-money Val	399	3.4110	7.6991	3.0188	3.8381
(6) Exit	650	0.0769	0.0025	0.0826	0.0712
(7) University Stake	650	30.9827	16.8667	45.3727***	16.4144
(8) Precedent Uni Stake	564	31.6372	12.0441	36.4252***	27.0161
(9) Nr of Founders	650	3.6308	2.2085	3.3486***	3.9164
(10) MBA	650	0.3231	0.4680	0.3700***	0.2755
(11) Entre Exp	650	0.4631	0.4990	0.4679	0.4582
(12) Avg. Work Exp	628	15.6499	8.9852	17.0840***	14.1975
(13) Prof Scientist	650	0.7400	0.4390	0.7798**	0.6997
(14) Oxbridge	650	0.2292	0.4207	0.2202	0.2384
(15) Russell Group	650	0.5092	0.5003	0.5841***	0.4334
(16) Non-Russell Group	650	0.2615	0.4398	0.1957***	0.3282
(17) Manufacturing	650	0.1631	0.3697	0.1468	0.1796
(18) IT	650	0.1800	0.3845	0.1437**	0.2167
(19) Scientific	650	0.5692	0.4956	0.6239***	0.5139
(20) Other Industries	650	0.0877	0.2831	0.0856	0.0898
(21) London	650	0.1477	0.3551	0.1223*	0.1734
(22) Rest of England	650	0.6323	0.4825	0.7187***	0.5449
(23) Scotland	650	0.1262	0.3323	0.1009*	0.1517
(24) Wales	650	0.0585	0.2348	0.0214***	0.0960
(25) Northern Ireland	650	0.0354	0.1849	0.0367	0.0341

Panel B: Variables defined at the university level

	Obs.	Mean	St.dev.
(1) Nr. university-owned spinouts	434	2.2926	3.3002
(2) Precedent Uni Stake	434	33.6796	13.6626
(3) Nr of disclosures	434	72.1152	82.3347
(4) Nr Patent Apps	434	41.6290	53.2632
(5) IP Expenditure	433	692.5935	1372.8530
(6) External Inv	434	39448.1060	113611.8000
(7) Startup Nr	434	0.8700	1.9674

Table 3: Pairwise Correlations

Table shows pairwise correlations. Variable numbers in Table 2, definitions in Table 1. Variables (2) and (4) are zero if spinout did not raise funding. Because earliest post-money valuation is only available for spinouts that raised funding, the correlation between variable (5) and (3) is not applicable. Significance: ***, **, * for 99%, 95%, 90% confidence levels.

Panel A: Variables defined at the spinout level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(2)	0.36***	1										
(3)	0.47***	0.17***	1									
(4)	0.30***	0.85***	0.23***	1								
(5)	0.09*	0.31***	NA	0.47***	1							
(6)	0.15***	0.29***	0.12***	0.33***	0.26***	1						
(7)	0.04	0.11***	0.09**	0.12***	0	0.04	1					
(8)	-0.04	-0.01	0.10**	0	-0.05	-0.01	0.42***	1				
(9)	0.15***	0.13***	0.17***	0.13***	0.04	0.12***	-0.12***	0.03	1			
(10)	0.03	0.06	0.03	0.05	0	0	0.14***	0.04	-0.01	1		
(11)	0.06	0.05	0.09**	0.06	0	0.04	0.05	0.04	0.13***	0.63***	1	
(12)	-0.05	0.09**	0.04	0.08**	0.08	0.08**	0.20***	0	0.06	0.15***	0.26***	1
(13)	0.05	0.10**	0.05	0.12***	0.11**	0.11***	0.15***	0.05	0.18***	0.12***	0.16***	0.33***

Panel B: Variables defined at the university level

	(1)	(2)	(3)	(4)	(5)	(6)
(2)	-0.09*	1				
(3)	0.65***	0.02	1			
(4)	0.58***	-0.03	0.73***	1		
(5)	0.67***	0.04	0.69***	0.61***	1	
(6)	0.57***	-0.06	0.43***	0.44***	0.56***	1
(7)	0.09*	-0.24***	0.09*	0.19***	0	-0.02

Table 4: OLS Regression of Determinants of University and Founding Team Equity Stake

Table presents OLS regressions for the determinants of the University Equity Stake. Unit: spinout level (cross-sectional analysis). 22 spinouts dropped due to missing founder work experience. Intercept included. Coefficients reported, robust standard errors in parentheses. Significance: ***, **, * for 99%, 95%, 90% confidence levels.

	DV: Uni Stake		
	(1)	(2)	(3)
Nr of Founders	-1.1667***	-1.1439***	-1.2325***
	(0.3429)	(0.3326)	(0.3263)
MBA	6.2406***	6.0831***	6.0127***
	(1.7468)	(1.7285)	(1.7063)
Avg Work Exp	0.3445***	0.2956***	0.2767***
	(0.0785)	(0.0783)	(0.0775)
Entre Exp	-3.8900**	-4.4029***	-4.0120**
	(1.7389)	(1.7025)	(1.6811)
Prof Scientist	4.2218***	3.8384**	3.8396**
	(1.6047)	(1.6176)	(1.5967)
Rest of England	4.7131**	4.9191**	6.3766***
	(1.9453)	(1.9384)	(1.9351)
Scotland	-0.0658	0.1342	1.1475
	(2.2679)	(2.2058)	(2.2960)
Wales	-5.7984*	-5.1199	-3.3146
	(3.1782)	(3.1917)	(3.2290)
Northern Ireland	3.1224	4.3302	3.5455
	(3.2837)	(3.4473)	(3.4523)
Manufacturing		-1.2434	-2.6485
		(2.6961)	(2.7118)
IT		-2.7161	-3.4424
		(2.4949)	(2.5010)
Scientific		2.9139	2.1839
		(2.2967)	(2.3240)
Oxbridge			-1.6675
			(2.0170)
Russell Group			4.7465***
			(1.6394)
Cohort fixed effects	No	Yes	Yes
Observations	628	628	628
R^2	0.1214	0.1760	0.2014

Table 5: Determinants of Probability of Fundraising Success

Table shows OLS/2SLS panel regressions for fundraising success determinants. Dependent variables: binary indicators for equity/VC yearly post-spinout. Intercept included. OLS/2SLS coefficients reported, standard errors in parentheses (clustered at spinout level). 22 spinouts dropped due to missing founder work experience, 36 spinouts dropped because they were less than one year old; the rest dropped in 2SLS specification due to the precedent stake not being available. 2SLS: university equity stake instrumented by average stake of same-university spinouts in prior 3-year period. Only instrumental variable coefficient/standard error shown in the first stage. Significance: ***, **, * for 99%, 95%, 90% confidence levels.

	DV: Raised VC		DV: Raised Eq	
	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
University Stake	0.0005	-0.0030***	0.0018**	0.0000
	(0.000)	(0.001)	(0.001)	(0.002)
Nr of Founders	0.0077**	0.0021	0.0227***	0.0232***
	(0.004)	(0.004)	(0.006)	(0.007)
MBA	-0.0102	0.0152	-0.0206	-0.0222
	(0.020)	(0.024)	(0.036)	(0.044)
Avg Work Exp	-0.0011*	-0.0008	0.0000	-0.0005
	(0.001)	(0.001)	(0.001)	(0.001)
Entre Exp	0.0116	0.0023	0.0395	0.0668
	(0.019)	(0.023)	(0.034)	(0.042)
Prof Scientist	0.0095	0.0378*	-0.0018	0.0189
	(0.013)	(0.020)	(0.026)	(0.033)
Rest of England	-0.0028	0.0049	0.0069	0.0168
	(0.016)	(0.020)	(0.031)	(0.032)
Scotland	0.0183	0.0161	0.0409	0.0421
	(0.020)	(0.025)	(0.040)	(0.043)
Wales	-0.0430***	-0.0516**	-0.0610*	-0.0608
	(0.017)	(0.021)	(0.037)	(0.042)
Northern Ireland	-0.0031	-0.0127	-0.0287	-0.0025
	(0.027)	(0.038)	(0.062)	(0.086)
Manufacturing	0.0309	0.0448*	0.0615	0.0898*
	(0.019)	(0.024)	(0.040)	(0.049)
IT	0.0344*	0.0462*	0.0393	0.0602
	(0.020)	(0.027)	(0.039)	(0.050)
Scientific	0.0268	0.0480**	0.0669*	0.0969**
	(0.017)	(0.022)	(0.036)	(0.044)
Oxbridge	0.1256***	0.1437***	0.2197***	0.2391***
	(0.023)	(0.027)	(0.044)	(0.050)
Russell Group	0.0141	0.0438***	0.018	0.0423
	(0.011)	(0.017)	(0.025)	(0.035)
Cohort fixed effects	Yes	Yes	Yes	Yes
Age fixed effects	Yes	Yes	Yes	Yes
Nr of Spinouts	592	513	592	513
Observations	2353	1887	1484	1226
R^2	0.1115	0.0835	0.287	0.2969
First Stage for 2SLS regressions				
		DV: Uni Stake		DV: Uni Stake
Precedent Uni Stake		0.5560***		0.6106***
		(0.076)		(0.069)
F-Statistics		53.1803		78.6745

Table 6: Determinants of Probability of Fundraising Success by Sector

Table presents OLS/2SLS panel regressions for fundraising success determinants in science-intensive and less science-intensive subsamples. Dependent variables: binary indicators for VC investment yearly post-spinout. Only OLS/2SLS coefficients for University Stake are reported, standard errors in parentheses (clustered at spinout level). 2SLS: university equity stake instrumented by average stake of same-university spinouts in prior 3-year period. Only instrumental variable coefficient/standard error shown in the first stage. Significance: ***, **, * for 99%, 95%, 90% confidence levels.

	DV: Raised VC			
	More Science-Intensive spinouts		**Less Science-Intensive spinouts**	
	(1)	(2)	(3)	(4)
	OLS	2SLS	OLS	2SLS
University Stake	0.0014**	-0.0022	-0.0007	-0.0045**
	(0.0006)	(0.0014)	(0.0006)	(0.0018)
Founding Team Characteristics	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
University Groups fixed effects	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes
Age fixed effects	Yes	Yes	Yes	Yes
Nr of Spinouts	336	294	256	219
Observations	1,324	1,091	1,029	796
R^2	0.1140	0.0882	0.1400	0.1170
First Stage for 2SLS regressions				
		DV: Uni Stake		DV: Uni Stake
Precedent Uni Stake		0.5985***		0.4896***
		(0.0832)		(0.1126)
F-Statistics		51.6973		18.9222

Table 7: Determinants of Amount Raised, Valuation and Exit

Table shows OLS/2SLS regressions for the determinants of the annual investment amount conditional on fundraising success, earliest post-money valuation and successful exit (defined as acquisition or IPO). For regressions (1) and (2), observations are the positive yearly post-spinout amounts. Dependent variable for (1) and (2): natural logarithm of funding from any source/VC firms. Excludes Wales spinouts for VC funding since they did not raise VC. Regression (3) is cross-sectional. Dependent variable for (3): natural logarithm of earliest available post-money valuation (i.e., if a round has missing valuation the next available valuation is used). For regression (4), observations are yearly binary outcomes for whether spinout exited. If spinout exited or is not old enough to reach the specified period, it is dropped from the regression for the corresponding spinout-year observation. Intercept included in all regressions. OLS/2SLS coefficients reported, standard errors in parentheses (clustered at spinout level for panel regressions). 2SLS: university equity stake instrumented by average stake of same-university spinouts in prior 3-year period. Only instrumental variable coefficient/standard error shown in the first stage. Only University Stake coefficient and standard error is shown for OLS/2SLS regressions. Significance: ***, **, * for 99%, 95%, 90% confidence levels.

Panel A: OLS regressions	DV: Log Annual VC Inv	DV: Log Annual Eq Inv	DV: Log Post-money Val	DV: Exit
	(1)	(2)	(3)	(4)
University Stake	0.0122*	0.0104**	0.0043	0.0001
	(0.0063)	(0.0048)	(0.0037)	(0.0001)
Founding Team Characteristics	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
University Groups fixed effects	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes
Age fixed effects	Yes	Yes	No	Yes
Nr of Spinouts	172	379	388	628
Observations	307	905	388	4004
R^2	0.3763	0.2905	0.2309	0.0196
Panel B: 2SLS regressions				
University Stake	0.017	0.0012	-0.0059	-0.0005
	(0.0193)	(0.0152)	(0.0120)	(0.0003)
Nr of Spinouts	155	330	339	546
Observations	267	771	339	3325
R^2	0.3816	0.2813	0.2108	0.0178
	First Stage for 2SLS regressions			
	DV: Uni Stake	DV: Uni Stake	DV: Uni Stake	DV: Uni Stake
Precedent Uni Stake	0.4179***	0.4485***	0.4754***	0.5568***
	(0.1213)	(0.0787)	(0.0768)	(0.0572)
F-Statistics	11.872909	32.4689	38.3322	94.7967

Table 8 - Determinants of the Number of newly formed university-owned Spinouts

Table presents fixed-effect panel regressions for determinants of the number of new university-owned spinouts formed. Dependent variables: the natural logarithm of 1 + the number of newly formed university-owned spinouts in a given academic year by a given university, as reported by HEBCI. Independent variables are specified as the average university characteristics over the previous three academic years, excluding the year under consideration. The moving average for IP Expenditure and External Investment is log-transformed. Coefficients from fixed effects estimation are reported, with the associated cluster-robust standard errors in parenthesis. Significance: ***, **, * for 99%, 95%, 90% confidence levels.

	DV: Log of number of newly-formed university spinouts						
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Precedent Uni Stake	-0.0075**	-0.0075**	-0.0078**	-0.0078**	-0.0075**	-0.0075**	-0.0080**
	(0.0036)	(0.0036)	(0.0037)	(0.0035)	(0.0036)	(0.0036)	(0.0037)
MA(3) Nr of Disclosures		0.0003					-0.0001
		(0.0018)					(0.0020)
MA(3) Patent Apps			0.0081*				0.0078
			(0.0045)				(0.0049)
MA(3) IP Expenditure				0.0744***			0.0619**
				(0.0246)			(0.0249)
MA (3) External Inv					-0.0020		0.0074
					(0.0224)		(0.0210)
MA(3) Startup Nr						-0.0084	-0.0018
						(0.0198)	(0.0175)
Academic Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nr of universities	62	62	62	62	62	62	62
University fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	434	434	434	434	434	434	434
R^2	0.0277	0.0278	0.0613	0.0408	0.0277	0.0280	0.0708

Table 9: Robustness check – Time-varying University Characteristics

Table presents 2SLS panel regressions for the determinants VC fundraising success, including the time-varying university characteristics from Table 8 as controls. HEBCI does not provide information for the academic year 2009-2010, so observations corresponding to 3 spinouts incorporated in that year are dropped from regressions (2)-(7). Dependent variables: binary indicators for VC yearly post-spinout. The moving average for IP Expenditure and External Investment is log-transformed. OLS/2SLS coefficients reported, standard errors in parentheses (clustered at spinout level). 2SLS: university equity stake instrumented by average stake of same-university spinouts in prior 3-year period. Only instrumental variable coefficient/standard error shown in the first stage. Significance: ***, **, * for 99%, 95%, 90% confidence levels.

	DV: Raised VC						
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
University Stake	-0.0030***	-0.0029***	-0.0031***	-0.0029***	-0.0032***	-0.0028***	-0.0027***
	(0.0011)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
MA(3) Nr of Disclosures		-0.0001					-0.0001
		(0.0001)					(0.0001)
MA(3) Patent Apps			-0.0001				0.0001
			(0.0003)				(0.0003)
MA(3) IP Expenditure				-0.0057			-0.0040
				(0.0050)			(0.0062)
MA (3) External Inv					0.0037		0.0060**
					(0.0026)		(0.0027)
MA(3) Startup Nr						0.0081*	0.0084*
						(0.0042)	(0.0047)
Founding Team Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
University Groups fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of spinouts	513	510	510	510	510	510	510
Observations	1,887	1,862	1,862	1,862	1,862	1,862	1,862
R^2	0.0835	0.0877	0.0847	0.0884	0.0832	0.0909	0.0954

Table 10: Robustness check – Alternative sector definitions

Table presents OLS/2SLS panel regressions for fundraising success determinants with an alternative sector definition, using fixed effects for each SIC Group. Dependent variables: binary indicators for VC yearly post-spinout. OLS/2SLS coefficients reported, standard errors in parentheses (clustered at spinout level). 2SLS: university equity stake instrumented by average stake of same-university spinouts in prior 3-year period. Only instrumental variable coefficient/standard error shown in the first stage. Significance: ***, **, * for 99%, 95%, 90% confidence levels.

	DV: Raised VC					
	All spinouts		**Science-Intensive spinouts**		**Less Science-Intensive**	
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	OLS	2SLS	OLS	2SLS
University Stake	0.0006	-0.0029***	0.0014**	-0.0022	-0.0007	-0.0048***
	(0.0004)	(0.0011)	(0.0006)	(0.0014)	(0.0006)	(0.0019)
Founding Team Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
University Groups fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Age fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Nr of Spinouts	592	513	336	294	256	219
Observations	2,353	1,887	1,324	1,091	1,029	796
R^2	0.1142	0.0899	0.1140	0.0882	0.1459	0.1225
First Stage for 2SLS regressions						
		DV: Uni Stake		DV: Uni Stake		DV: Uni Stake
Precedent Uni Stake		0.5742***		0.5985***		0.5108***
		(0.0794)		(0.0832)		(0.1143)
F-Statistics		52.3037		51.6973		19.9686

Table 11: Robustness check – Probit and IV-Probit Regressions

Table presents panel regressions for fundraising success determinants using Probit and IV-Probit models. Probit and IV-probit drop some observations whenever there are fixed effects that predict success perfectly. Dependent variables: binary indicators for VC investment yearly post-spinout. Probit/IV-Probit coefficients reported, standard errors in parentheses (clustered at spinout level). IV-Probit: university equity stake instrumented by average stake of same-university spinouts in prior 3-year period. Only instrumental variable coefficient/standard error shown in the first stage. Significance: ***, **, * for 99%, 95%, 90% confidence levels.

	DV: Raised VC					
	All spinouts		**Science-Intensive spinouts**		**Less Science-Intensive spinouts**	
	(1)	(2)	(3)	(4)	(5)	(6)
	Probit	IV-Probit	Probit	IV-Probit	Probit	IV-Probit
University Stake	0.0048*	-0.0205***	0.0102**	-0.0119	-0.0040	-0.0352***
	(0.0029)	(0.0076)	(0.0040)	(0.0105)	(0.0047)	(0.0106)
Founding Team Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
University Groups fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Age fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Nr of Spinouts	557	481	319	279	238	193
Observations	2,025	1,651	1,145	960	836	609
First Stage for 2SLS regressions						
		DV: Uni Stake		DV: Uni Stake		DV: Uni Stake
Precedent Uni Stake		0.5144***		0.5332***		0.6273***
		(0.0752)		(0.0838)		(0.0898)

Appendix 1: Theory Proofs

We assume that all parties are risk-neutral, and there is no discounting. We denote the three players as U for the university (typically represented by the technology transfer office), S for the scientist, and M for the manager. At date 0, there are n scientists with a research discovery. The intellectual property (IP) belongs to the university. To turn the discovery into a potential spinout requires any S to perform additional work at a private effort cost e_S. The probability of reaching the spinout stage at date 1 is given by $p = p_0(e_S)^\sigma$. With probability $1 - p$, no spinout is formed and all parties receive zero utility going forward.

If there is a spinout at date 1, we assume (for now) that a new manager M is needed. M provides effort to raise venture capital (VC), at a private effort cost e_R. The success probability of raising VC is given by $r = r_0(e_R)^\rho$. With probability $1 - r$ no money is raised and all parties receive zero utility going forward. With r, however, the value of the spinout is given by x. We assume this to be a constant (or equivalently the expected value of some random variable). For simplicity we stop the game at date 2, but x can also be thought of as the expected value of a continuation game after date 2. This way, x is the pre-money valuation in the VC round, reflecting the joint value held by S, M, and U.

U controls the spinout and allocates equity in proportions α_i, $i = S, M, U$ with $\alpha_S + \alpha_M + \alpha_U = 1$. Technically, we assume binding wealth constraints, so that no party can buy out another party's equity stake. We also assume zero outside options for S and M.

To solve the model we start by looking at M's utility after date 1, denoted by $v_M = rx\alpha_M - e_R$ or $v_M = (e_R)^\rho r_0 x\alpha_M - e_R$. The first-order condition for the optimal e_R is given by $\rho(e_R)^{\rho-1} r_0 x\alpha_M - 1 = 0$. (The second-order condition holds because $\rho(\rho - 1)(e_R)^{\rho-2} r_0 x\alpha_M < 0$; similar proofs apply to all other second-order conditions). Solving the first-order condition we obtain $e_R = (\rho r_0 x\alpha_M)^{\frac{1}{1-\rho}}$. We use this to obtain $r = r_0(\rho r_0 x\alpha_M)^{\frac{\rho}{1-\rho}}$. We immediately note that r is an increasing function of α_M. This establishes Proposition 2.

We use this in the above expression of v_M and obtain after transformation $v_M = \widehat{\rho}(\rho r_0 x\alpha_M)^{\frac{1}{1-\rho}}$ where $\widehat{\rho} = (\rho)^{\frac{\rho}{1-\rho}} - (\rho)^{\frac{1}{1-\rho}}$. It is useful to define $R_0 = (r_0 x)^{\frac{1}{1-\rho}}$ then U's utility at date 1 is given by $v_U = rx\alpha_U$. Using $\alpha_U = (1 - \alpha_M - \alpha_S)$ this becomes $v_U = R_0(\rho\alpha_M)^{\frac{\rho}{1-\rho}}(1 - \alpha_M - \alpha_S)$. We also find S's utility at date 1 as $v_S = rx\alpha_S = R_0(\rho\alpha_M)^{\frac{\rho}{1-\rho}}\alpha_S$.

At date 0, we examine S's effort incentives. S's utility is given by $V_S = pv_S - e_S = p_0(e_S)^\sigma v_S - e_S$. The first-order condition is given by $\sigma(e_S)^{\sigma-1} p_0 v_S - 1 = 0$. Solving this, we obtain $e_S = (\sigma p_0 v_S)^{\frac{1}{1-\sigma}}$. With this we obtain $p = p_0(\sigma p_0 v_S)^{\frac{\sigma}{1-\sigma}}$. From the expression of v_S above we know that, for a given α_M, v_S is an increasing function of α_S. This establishes Proposition 1.

We now obtain the following ex-ante utilities. We have $V_S = \widehat{\sigma}(p_0 v_S)^{\frac{1}{1-\sigma}}$ where $\widehat{\sigma} = \sigma^{\frac{\sigma}{1-\sigma}} - \sigma^{\frac{1}{1-\sigma}}$. For U's ex-ante utility we use $V_U = pv_U$ which after transformation yields

$$V_U = (R_0 p_0)^{\frac{1}{1-\sigma}}(1 - \alpha_M - \alpha_S)(\alpha_S)^{\frac{\sigma}{1-\sigma}}(\rho\alpha_M)^{\frac{\rho}{1-\rho}\frac{1}{1-\sigma}}.$$

Maximizing V_U w.r.t. α_M and α_S is equivalent to maximizing

$$\log(V_U) = \frac{1}{1-\sigma}\log(p_0 R_0) + \log(1-\alpha_M-\alpha_S) + \frac{\sigma}{1-\sigma}\log(\alpha_S) + \frac{\rho}{1-\rho}\frac{1}{1-\sigma}\log(\rho\alpha_M).$$

This generates the following two first-order conditions

$$\frac{1}{\alpha_S}\frac{\sigma}{1-\sigma} = \frac{1}{1-\alpha_M-\alpha_S} \text{ and } \frac{1}{\alpha_M}\frac{\rho}{1-\rho}\frac{1}{1-\sigma} = \frac{1}{1-\alpha_M-\alpha_S}.$$

We solve these to find that $\alpha_M = \rho$ and $\alpha_S = \sigma(1-\rho)$ so that $\alpha_U = (1-\sigma)(1-\rho)$. This establishes Proposition 3.

Now consider the model where S transitions to manage the spinout herself. At date 1, we have the same optimization, except that we use α_S instead of α_M. We thus get $r = r_0(\rho r_0 x \alpha_S)^{\frac{\rho}{1-\rho}}$ so that Proposition 2 continues to hold. At date 0, we get the same optimal effort $e_S = (\sigma p_0 v_S)^{\frac{1}{1-\sigma}}$, except that v_S and v_U are now given by $v_S = R_0\widehat{\rho}(\rho\alpha_S)^{\frac{1}{1-\rho}}$ and $v_U = R_0(1-\alpha_S)(\rho\alpha_S)^{\frac{\rho}{1-\rho}}$. Again we get $p = p_0(\sigma p_0 v_S)^{\frac{\sigma}{1-\sigma}}$ so that Proposition 1 continues to hold.

To derive U's optimal equity allocation, we use $V_U = pv_U = p_0(\sigma p_0 v_S)^{\frac{\sigma}{1-\sigma}} v_U$. After some transformations we obtain

$$\log(V_U) = \zeta_1 + \log(1-\alpha_S) + \frac{1-(1-\rho)(1-\sigma)}{(1-\rho)(1-\sigma)}\log(\alpha_S)$$

where ζ_1 is a term that does not depend on α_S or α_U. Solving the first-order condition

$$\frac{1-(1-\rho)(1-\sigma)}{(1-\rho)(1-\sigma)}\frac{1}{\alpha_S} = \frac{1}{1-\alpha_S},$$

we obtain $\alpha_S = 1-(1-\rho)(1-\sigma)$ and $\alpha_U = (1-\rho)(1-\sigma)$. This establishes Proposition 4.

Finally, consider the following simple bargaining model. We assume that U has a default policy of taking the optimal stake $\alpha_U^* = (1-\rho)(1-\sigma)$. However, spinout founders can always try to negotiate down the university stake. Specifically, we assume that every S requests U to make some concession. We thus examine U's decision at date 1 to either stick to its default policy, or make a concession and accept a lower stake. We assume that sticking to the default policy requires U to incur some bargaining costs $\widetilde{c} \in [0,\infty)$, with some distribution $\Omega(\widetilde{c})$. These bargaining costs can be avoided by making a concession which involves giving up some (exogenous) equity stake δ, where $0 < \delta < \alpha_U^*$. We denote the increased equity stakes of S and M by δ_S and δ_M, satisfying $\delta_S + \delta_M = \delta$.

U's utility at date 1 can be written as $v_U = R_0(\alpha_U)(\rho\alpha_M)^{\frac{\rho}{1-\rho}}$. If U sticks to its default policy, then it receives a utility $v_U^{Default} = R_0(\alpha_U^*)(\rho^2)^{\frac{\rho}{1-\rho}} - \widetilde{c}$. If it makes a concession, it receives a utility of $v_U^{Concession} = R_0(\alpha_U^*-\delta)(\rho(\rho+\delta_M))^{\frac{\rho}{1-\rho}}$. Thus, the condition for sticking to the default policy is given by

$$\Delta \equiv v_U^{Default} - v_U^{Concession} = R_0(\rho)^{\frac{\rho}{1-\rho}}[(\alpha_U^*)(\rho)^{\frac{\rho}{1-\rho}} - (\alpha_U^*-\delta)(\rho+\delta_M)^{\frac{\rho}{1-\rho}}] - \widetilde{c}.$$

The term in the square brackets is always positive due to the optimality of α_U^* (otherwise U would have made the concession δ voluntarily). Thus, there exists some critical value $\widehat{c}$ such that $\Delta(\widehat{c}) = 0$. For all $c > \widehat{c}$, bargaining costs are too high and U makes the concession. For all $c < \widehat{c}$, bargaining costs are low enough for U to stick to its default policy. The probability of sticking to the default policy (and thus retaining a higher university stake) is given by $\Omega(\widehat{c})$.

To see how this probability depends on the quality of the spinout, we focus on the success value x. Recall that $R_0 = (r_0 x)^{\frac{1}{1-\rho}}$, so that R_0 is an increasing function of x. It follows that $\dfrac{d\Delta(\widehat{c})}{dx} > 0$. Totally differentiating $\Delta(\widehat{c}, x) = 0$ we obtain $\dfrac{d\Delta}{dc}(\widehat{c})\dfrac{d\widehat{c}}{dx} + \dfrac{d\Delta(\widehat{c})}{dx} = 0$. Using $\dfrac{d\Delta}{dc}(\widehat{c}) = -1$, we obtain $\dfrac{d\widehat{c}}{dx} = \dfrac{d\Delta(\widehat{c})}{dx} > 0$. This says that the critical value below which U sticks to its default policy is increasing in x. It follows that the probability of sticking to the higher university stake, $\Omega(\widehat{c})$, is an increasing function of the spinout quality x. This establishes Proposition 5.

Appendix 2: Filtering criteria applied to our sample

The following table shows the filtering criteria applied to the initial sample of 1103 spinouts identified by Beauhurst. After applying the criteria, we are left with a final sample of 650 spinouts.

Filtering criteria	**Nr**	**Example**	**Reason for exclusion**
Missing or 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	40	This could be due to many reasons, which we are not able to observe: 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 spinouts from our sample.
Startup instead of spinout	6	Startups formed out of university incubators.	It is not clear that these are university spinouts. 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 spinouts.
RCA spinout	56	It is not clear whether these are student startups or university spinouts.	
Non-university spinout	10	Spinout of university spinouts.	
Uni stake <1%	335		We are interested in studying the implications of marginal increases in the University Stake.

Appendix 3: Method of inferring the spinout date

Since universities do not disclose the official spinout date, we utilize frequent administrative filings to infer it. Instead of relying on the annual filings of the capitalization tables, we use the following SH forms to increase the accuracy of dating the spinout events: SH01 forms (filed when new shares are allotted), SH02 forms (filed when shares are subdivided), SH06 forms (filed when shares are cancelled) (Companies House, 2021). When multiple SH forms were filed in the year before the relevant capitalization table, we rely on the Articles of Association (AoA) to minimize the noise. The AoA is a legal document that sets out the rules and regulations governing the internal management and operation of a company (Companies House, 2021). Below we provide the definition of the inferred spinout date, depending on the availability of filing:

Case	Defintion of the Inferred Spinout Date
(1) The relevant capitalization table is contained in the Certificate of Incorporation.	The inferred spinout date is equal to the incorporation date as specified in Companies House.
(2) There is only a single SH form filed between the relevant capitalization table and the capitalization table immediately preceding it	The inferred spinout date is equal to the date of SH form.
(3) There are multiple or no SH forms, but there is exactly one AoA filed between the relevant capitalization table and the capitalization table immediately preceding it.	The Inferred spinout date is equal to the date of AoA.
(4) There are multiple or no SH forms, but there is more than one AoA filed between the relevant capitalization table and the capitalization table immediately preceding it.	The inferred spinout date is equal to the midpoint of the dates of the earliest and latest AoAs filed between the capitalization tables.
(5) There is no AoA filed between the relevant capitalization table and the capitalization table immediately preceding it. However, multiple SH forms have been filed between the capitalization tables.	The inferred spinout date is equal to the midpoint of the date of the earliest and latest SH form filed between the capitalization tables.
(6) There is neither an SH form nor an AoA filed between the relevant capitalization table and the capitalization table immediately preceding it.	The inferred spinout date is equal to the midpoint of the date of the complete capitalization table and the capitalization table immediately preceding it.

Our methodology for dating the spinout event is prone to error when there are multiple SH forms filed. In order to minimize the noise, we also use information on the type of investors involved in each round, assuming that private investors would not invest in the spinout before the equity distribution deal between the spinout and the university is finalized, due to concerns about how university stake may potentially affect founders' incentives. The government, university, or charities, on the other hand, may well do so to support the creation of the spinout. Hence, the spinout date is taken to be the minimum between our inferred spinout date and the date of the earliest round where any investor other than the government, university or non-for-profit organizations participated.

Appendix 4: Summary of the Deals between the University and University-affiliated Funds

According to publicly available information, we identify the following deals, where the university either partially or fully outsources its commercialization services to a university-affiliated fund. In exchange, the fund gets full or part of the university IP shares.

- Imperial College London fully outsourced its commercialization services to Touchstone Innovations (RSM, 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 (see for e.g., Investgate (2005), IPGroup 2021)
- Oxford University had additional (partial) commercialization deals with Oxford Sciences Enterprises Ltd and Technikos LLP (see for e.g., University of Oxford (2023), The Engineer (2005))

Appendix 5: Shareholder classification

A **scientist** is defined as any shareholder who was involved in developing the technology which the spinout is based on. The judgement call to determine involvement with technology relies on the following description:

In some cases, the company website mentions explicitly that the shareholder was involved with the technology. In this case, we classify him as involved. 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 spinout event. If the shareholder was not affiliated with any university and did not study in a field related to spinouts activity, we classify him/her as non-scientist. If the shareholder was affiliated with the university and studied/did research/taught in an area similar to the spinouts 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 spinout 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 spinout at the inferred spinout date (see section 3.2 for the method of inferring the spinout date). The judgement call to determine whether a shareholder had an executive position relies on the following description:

If the job title/role within the spinout 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 spinout 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 shareholder as non-manager.

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

1. Scientists who develop the technology but who do not get involved in the running of the spinout after the spinout event (Remaining Scientists)
2. Scientists who give up their academic position and transition into running the firm (Transitioning Scientists)
3. Managers who are brought in to run the venture, but who have not contributed to the technology (New Managers)

For our analysis, the spinout founding team is composed of remaining scientists, transitioning scientists and new managers. We also include as members of the founding team any advisors who join at the spinout event.

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

1. Explicit evidence he/she/entity is an investor;
2. Wealthy individual with no clear employment link to spinout;
3. Representatives of investment funds;
4. Person holds (now or in the past) multiple positions as director/board member in different companies (classified as investor even if he is listed as advisor/non-executive members in the spinout 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 spinouts not in overlapping field – co-investment networks;
8. If no information on Y but he has same stake as X who was classified as investor, Y classified as investor;
9. Nominees for which there is no information on underlying structure.

Appendix 6: Rescaling of University Stakes

External investors could represent deals made before or after the actual spinout event. They are excluded from the university stake calculation to avoid a mechanical dilution of the university stake. Assuming the investment was made after the spinout event, spinouts where an external investor is part of the 'relevant capitalization table' would otherwise have a lower university stake and better fundraising outcomes. The following example illustrates this point.

Suppose we observe the following 'relevant capitalization table':

> Founder 1: 30%; Founder 2: 30%; Investor 1: 5%; Investor 2: 10%; and University: 25%.

Because our goal is to uncover how equity stake is initially split between the founders and the university, we need to remove the investors from the capitalization table. To do so, we subtract investor shares from 100% and rescale founders and university shares: 100%-(5%+10%)=85%. The rescaled capitalization table thus becomes:

> Founder 1: 30/85=35.3%; Founder 2: 30/85=35.3%; University: 25/85=29.4%.

Notice the danger of using the 'unscaled' university stake in the analysis. Ventures that would have investors in the 'relevant capitalization table' would have a lower unscaled university stake than ventures with no investors in the cap, even if the deal between the founders and the university at the spinout event would be the same across the ventures. If these investments were made after the spinout date, there would be a negative correlation between the university stake and investment raised post spinout event simply due to the dilution in university stake when investors join.

Apart from external investors being part of the 'relevant capitalization table,' the university and university-affiliated funds could themselves have invested. Observing that a spinout has not raised any investment post-spinout event could be due to the spinout not needing funding during that time horizon, or the spinout needing funding but being unable to raise any due to poor performance. Since a spinout that has already raised some funding from the university/affiliated fund may have fulfilled its fundraising objective, including university investment in the definition of university stake may result in a spurious negative correlation between the university stake and our measures of spinout performance.

Appendix 7: Method of Calculating the University IP Stake

We define the three main entities which could hold shares in exchange for transferring/licensing IP rights to the founding team:

Definition A1 (university): University shareholding is defined as holdings by any of the following entities appearing in the capitalization table:

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 evidence that it holds IP shares on behalf of the university through publicly available information. These entities are either fully owned by the university (e.g., Cambridge Enterprise Ltd) or owned by an entity which itself has been fully owned by the university, at a point in our sample period. (e.g., Ulive Enterprises Limited)

Definition A2 (trusts): We include here shareholdings of any other entities which appear alongside the university and which the company spun out from jointly (e.g., Cambridge University Hospitals NHS foundation trust). These entities are not necessarily owned by the university, but can claim IP due to spinout founders being affiliated with them or receiving grant funding from them.

Definition A3 (university-affiliated fund): Funds which may or may not be owned by the university, but for which we found evidence of having an agreement to provide some (or all) of the commercialization services to newly formed spinouts. In exchange, the university transfers a part (or all) of the IP shares to them. Examples include Oxford Science Enterprise Limited, Touchstone Business Ltd, IP2IPO etc.

We next describe our methodology in detail. The end goal is to calculate the IP stake held jointly by the university, university-affiliated funds, and trusts. There are two Companies House filings we utilize for this purpose:

1. Confirmation Statements which are filed annually and contain annual capitalization tables.
2. SH01 forms, which companies are legally required to file within a 30-day period of allotting new shares. The SH01 forms contain the number of shares issued, the class of shares, price, and notes on non-cash considerations for the issued shares. However, it does not contain which shareholder holds the issued shares.

Even though SH01 forms do not provide the identity of the shareholder the shares go to, the price per share paid by shareholders and/or university IP shares can still be easily identified or inferred in the following cases:

1. The complete capitalization table is contained in the Certificate of Incorporation, which lists price per shares held by each shareholder.
2. The complete capitalization table is filed in CS subsequent to the Certificate of Incorporation, but any of the following applies:
    a. All shares are priced at a unique price (equal to the nominal value which is usually negligible e.g., 0.001 GBP/share).
    b. Different classes of shares are issued, with unique prices per each class. Because the Confirmation Statement notes down the class of shares held by shareholders, it is easy to identify the price per share paid by the university and founders on the different classes of shares they hold.

c. The SH01 form explicitly mentions under non-share considerations that a given number of shares were allocated for licensing/transferring of Intellectual Property rights. We consider this as sufficient evidence to identify university IP shares.
d. The number of shares held by different shareholders is issued as separate blocks in the SH01 forms. In this case we utilize information on blocks to infer price per share for shareholders holding the particular block.

Example A4 (different classes of shares): According to the Confirmation statement, the founding team holds 2000 ordinary shares and 100 Series A shares, university holds 1200 ordinary shares, and 100 Series A shares and investors hold 2450 series A shares. SH01 forms issue 3200 ordinary shares at 0.01 GBP/share and 2650 series A shares priced at 100 GBP/shares. As a result, the founding team holds 2000 shares priced at 0.01 and 100 shares priced at 100, the university holds 1200 shares priced at 0.01 and 100 shares priced at 100, and investors hold 2450 shares priced at 100.

Example A5 (block information): According to the Confirmation statement, the founding team holds 5400 shares, university holds 1200 shares and investors hold 2450 shares. SH01 forms issue 5400 shares at 0.01 GBP/share, 1200 shares at 0.01 GBP/share and 2450 shares at 50 GBP/share. We consider this as sufficient evidence to infer that founder and university shares are priced at 0.01 and investor shares are priced at 50.

However, there can also be more complicated cases when SH01 forms do not have the information needed to infer the price per share for different shareholders in the CS. From our private interviews and second-look sample of data we received from particular universities, founders seem to be less likely to invest compared to the university. Indeed, whenever there are unique prices per share class as in Example 1, we observe founders holding the priced class of shares rarely. Whenever we cannot allocate issued shares to shareholders according to any of the evidence listed in Cases 1-2, we make the following assumption.

Assumption A6 *(pecking-order):* Issued shares, ordered from the lowest priced to the highest, are allocated to shareholders in the following priority:

1. Founding team
2. University as well as any other entity which the company spun out from (e.g., NHS hospitals, RBG Kew gardens etc)
3. University-Affiliated funds.
4. Investors/Unknowns

Example A7 *(pure pecking order)***:** In CS founders hold 2000 shares whereas university holds 4000 shares. According to SH01 forms, 10,000 ordinary shares are issued in total. 5000 are priced at 0.01 GBP/share and 1000 are priced at 20 GBP/share. Assumption A1 then suggests that founders hold 4000 shares at 0.01 GBP/share, university holds 1000 shares at 0.01 GBP/shares and 1000 shares at 20 GBP/share

Example A8 *(block information and pecking order)***:** According to the Confirmation statement, founders hold 5400 shares, university holds 1200 shares and investors hold 2450 shares. SH01 forms issue the following block of shares: 5300 shares at 0.01 GBP/share, 1200 shares at 0.01 GBP/share and 2550 shares at 50 GBP/share. Because the block of university shares is issued separately at 0.01 GBP/share, the university is allocated 1200 shares at 0.01. By our pecking order assumption, founders have priority of receiving free shares over the investors. Hence founders hold 5300 shares priced at 0.01 GBP/share and 100 shares at 50 GBP/share. Investors thus hold 2450 shares at 50 GBP/share.

Free shares are defined 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 IP stake and has solely made an investment into the spinout.

Definition A9 *(free shares)***:** Free shares are defined as shares with a price per share equal to the lowest priced shares held by founders/employees

Definition A10 *(IP shares)***:** University IP shares are the number of free shares held jointly by the university, university-affiliated funds, and trusts

Definition A11 *(IP stake)***:** University IP stake = University IP shares*100/ (University IP shares + Free founding team shares)